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LIGHT AUGER DRILLING FOR PLACER PROSPECTING

IN THE KLONDIKE DISTRICT, YUKON

A PILOT PROJECT

By

Diane Brent, Bsc
Canada/Yukon Geoscience Office

Canada

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ABSTRACT

The main purpose of this study was to test a prototype mobile, lightweight, low ground impact, all-terrain (ATV) mounted drill for grassroots placer exploration programs. The ATV drill was used to drill twenty-three 3.5 in. (89 mm) and 4.5 in. (114 mm) holes on ten different sites in the Klondike placer mining district. Holes were drilled until bedrock or "refusal" was encountered. Each hole was stratigraphically logged and sampled at regular intervals. Granular samples were washed and panned for placer gold; the gold was weighed and values were calculated.

In unconsolidated material, penetration rates for the ATV drill ranged from 3 ft./hr (0.9 m/hr) in frozen sandy pebble/cobble gravel to 33 ft./hr (10 m/hr) in unfrozen loose muck. Drilling penetration was influenced by: 1) extent of freezing, 2) clast size, 3) distribution of clast size, and 4) degree of cohesiveness. Out of twenty-three holes, twelve reached bedrock and thirteen were gold bearing. Maximum drill hole depth reached was 36 ft. (11 m). Eleven holes were drilled adjacent to previously drilled larger diameter holes for gold value correlations. Six of of these holes were known to be gold-bearing; our drilling indicated the presence of gold in five out of six holes. Small gold particles recovered from our drilling have a variety of shapes which range in size from 0.1 mm to 2 mm.

The ATV drill rig field tested in this study met most of the objectives of this project but gave mixed results. The ATV drill rig:

- is limited to terrain of relatively smooth microtopography
- is helicopter transportable but requires a medium size helicopter
- can penetrate most surficial materials found in typical Klondike placer deposits except for coarse gravels and some frozen gravels
- is an acceptable tool for studying the general stratigraphy of Yukon placer deposits, although vertical sections are more representative of stratigraphy
- can detect the presence of gold in penetrable stratigraphy
- recovered gold from virtually every gold bearing hole previously drilled by larger drill rigs but gold values were not as accurate as results from larger diameter drilling.

This particular ATV drill rig is limited by an old technological design and worn mechanical components which make it unsuitable for future projects of similar nature. However, the results of this project demonstrate that light weight and portable auger drilling has potential as a **prospecting tool**, particularly in drainage basins with limited geoscientific information and/or placer mining history.

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1 INTRODUCTION

1.1 Auger Drilling in the Yukon

The use of auger drilling for placer deposit exploration has risen in popularity over the past five years in Yukon. Much of this auger drilling is used by placer miners to delineate gold reserves on already developed properties. Some drilling is being done on new placer mining properties with larger auger drills mounted on track-propelled carriers ("NODWELL") (Plate 1). This project stems from an anticipation of the future need for low impact, mobile, lightweight drills, which can be used for prospecting purposes in drainage basins which have traditionally received little attention from the placer mining industry.

1.2 Objectives

1) To test a mobile, light auger drill (e.g. the ATV drill) which could be used for grassroots exploration or prospecting of placer gold deposits under Yukon conditions.

2) To evaluate the ATV drill for future helicopter supported grassroots exploration.

3) To evaluate drilling performance through the variety of surficial materials encountered in alluvial placer deposits, under different permafrost conditions in the Klondike district.

4) To study the stratigraphy at various placer deposits in the Klondike district, including depth to bedrock, gravel and muck characteristics, and permafrost conditions.

5) To test 3.5 in. and 4.5 in. diameter auger drilling in terms of placer gold recovery on currently active placer properties.

6) Wherever possible, to compare gold results with those obtained from reserve delineation drilling using larger drill rigs.

1.3 Location and Access

The study area is informally referred to as the Klondike Goldfields, southeast of Dawson City and straddles the Stewart River (115 N/O) and Dawson (116 B/C) map sheets. The area comprises the most active placer mining district in Yukon

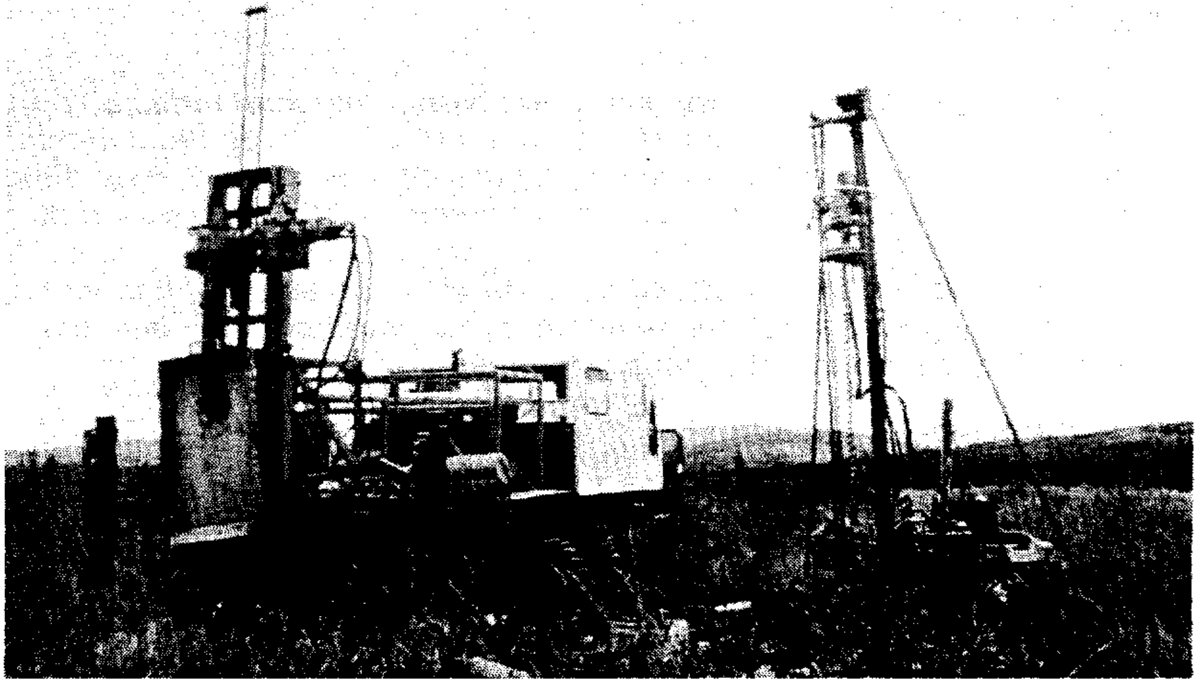


Plate 1: ATV drill (right) and standard Nodwell mounted drill (left) commonly used in the Klondike District.

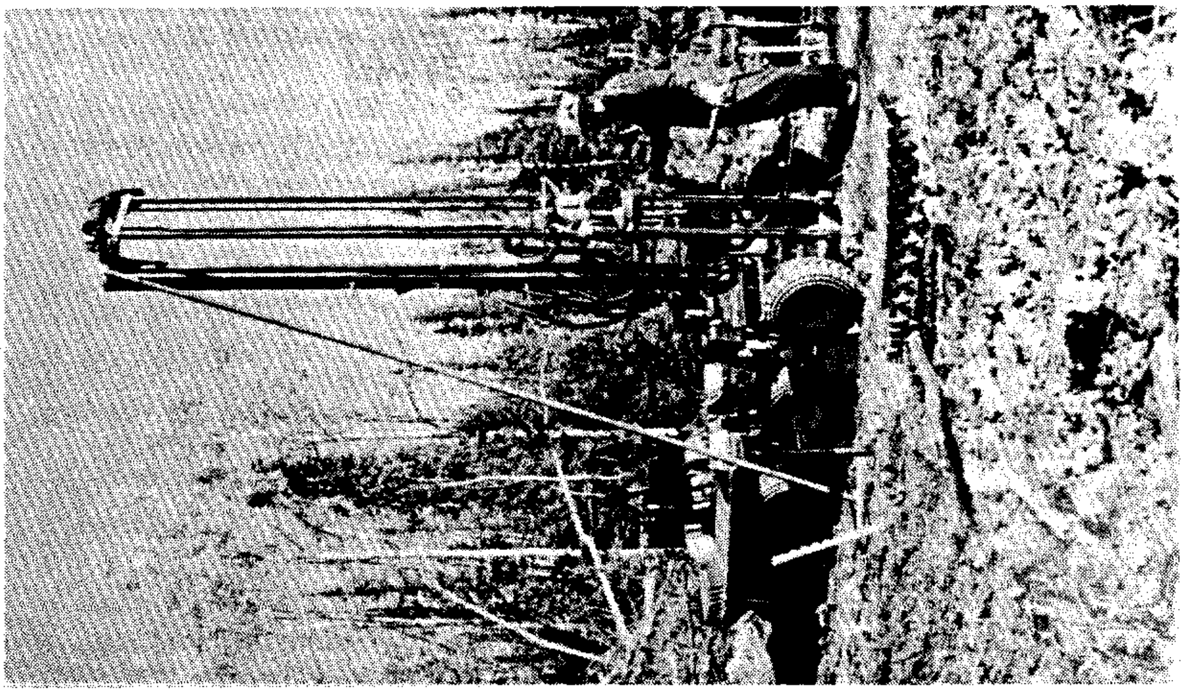


Plate 2: ATV drill.

Territory (Fig. 1), and lies within the Klondike River drainage basin to the north and the Indian River drainage basin to the south. Important placer gold producing tributaries of the Klondike District include Hunker, Bonanza, Dominion, Sulphur, and Quartz Creek.

Access to the area is facilitated by a network of mining roads branching off the main Hunker Creek, Dominion Creek and Bonanza Creek 2-wheel drive roads. All drill sites for this project were road accessible with a 4-wheel drive all-terrain vehicle.

1.4 Previous Work

Little published information is available on drilling for placer deposits in the Yukon, particularly lightweight drilling. In most cases, emphasis is placed on drilling as a tool for reserve delineation using larger, heavier drills. Clarkson (1993) has published a comprehensive report on gold recovery using two types of placer drills: auger and reverse circulation drills.

The "ATV drill", a prototype owned by the Geological Survey of Canada, was tried out for the first time in the Yukon, during September and October 1994. It had been used for several seasons for the purpose of surficial geology and permafrost investigation and mapping in the high Arctic and in eastern Canada but had never been used for drilling placer deposits. Veillette and Nixon (1980) provide a brief summary of the original ATV drill, although it has undergone additional modifications since. Colp (1982) provides an overview of other drill types used by the placer industry.

1.5 Regional Geology

The Klondike placer mining district is underlain by rocks of the Yukon-Tanana tectonic terrane (Fig. 2) which mainly comprises polydeformed metamorphic rocks of Late Devonian to Middle Permian age (Mortenson, 1990, Knight et al., 1994). Lithology types include a variety of mafic to felsic metavolcanic, metaplutonic, and metasedimentary rocks. Greenstones and altered ultramafic rocks of the Slide Mountain terrane were later emplaced along thrust faults following an initial phase of deformation. Unmetamorphosed interbedded sedimentary and volcanic rocks of Cretaceous age locally overlie the older units. Cretaceous to Eocene intrusive rocks mainly comprising granodiorite and porphyritic basalt and diabase also postdate faulting. The youngest rocks consist of Eocene quartz-feldspar porphyry and felsic tuff. The Klondike area is bounded by the Tintina fault to the east.

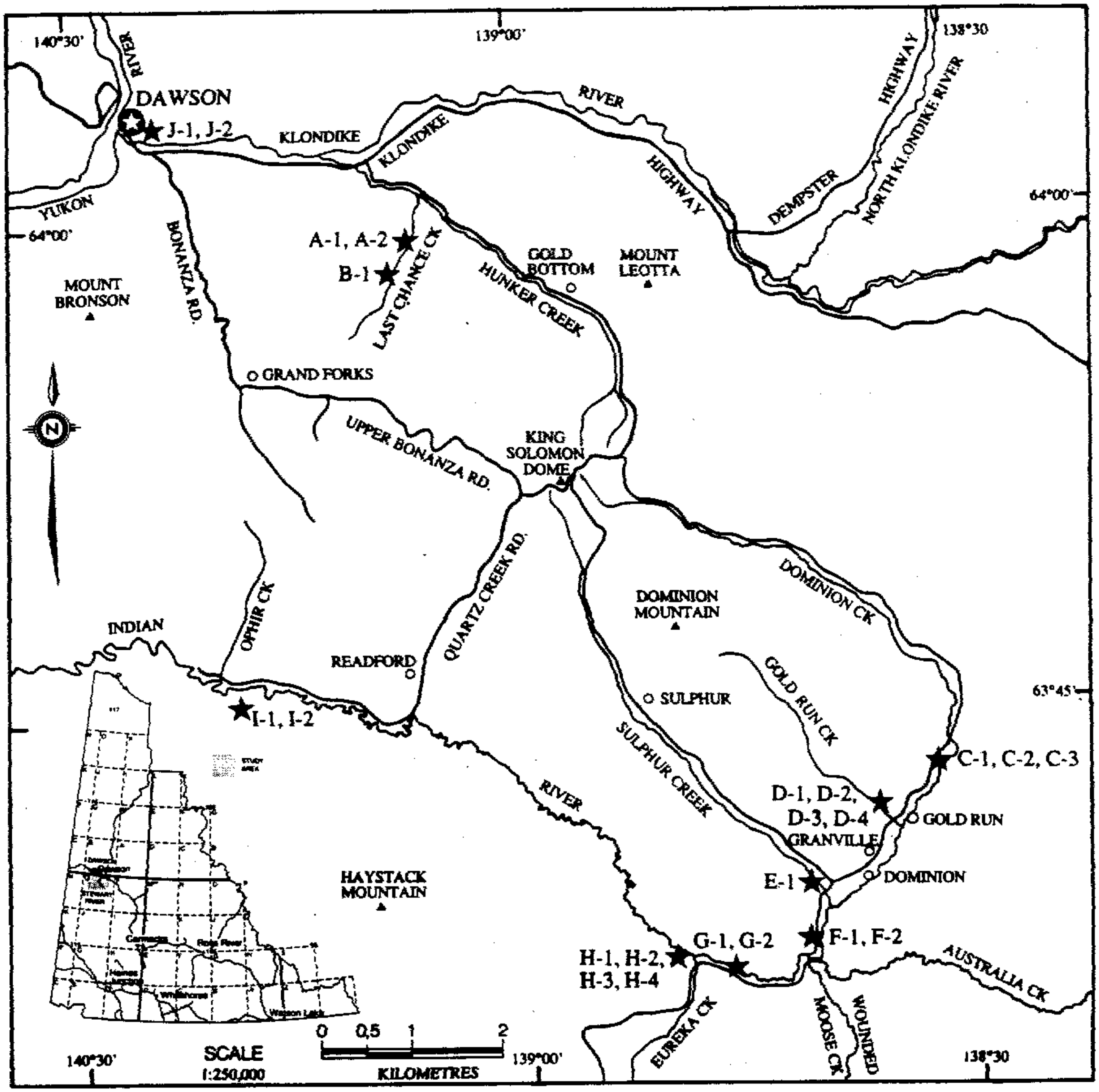


Figure 1: Location Map of ATV Drill Sites (scale 1:250,000).

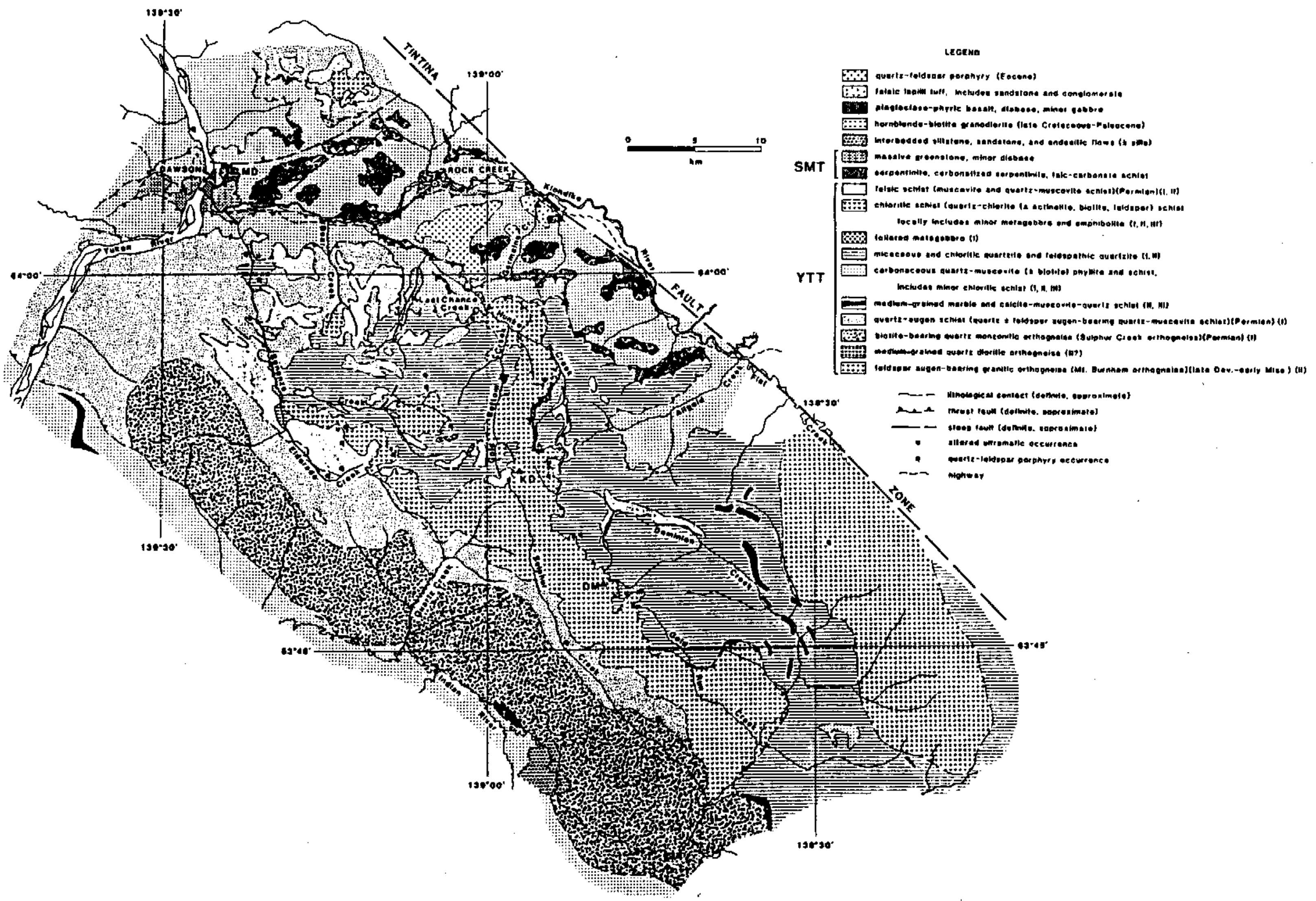


Figure 2: Regional Geology Map of the Klondike District (from Mortensen, 1990). MD=Midnight Dome; KD=King Solomon Dome; DM=Dominion Mountain; MB=Mount Burnham

1.6 Placer Deposit Geology

Physiographically, the Klondike placer mining area lies within the unglaciated Klondike Plateau, a subdivision of the Yukon Plateau. The latter is described as "an uplifted erosional surface of Tertiary age characterized by dissected, rolling terrain of accordant ridges" (Bostock, 1948, 1970; Templeman-Kluit, 1980; Knight et al.,1994). The main drainages flow to the north and south.

Bedrock terraces are generally overlain by two gravel units: the older (Pliocene) auriferous White Channel gravel sequence and the (Pleistocene) Klondike glacially derived gravel sequence. As a result of tectonic uplift during the Pleistocene, drainage systems were deeply incised to their current levels (Hughes et al.,1972), leaving older gravel terraces 50 to 100 metres above modern drainage levels (Morison, 1985). An intermediate stage of drainage incision resulted in the formation of river terrace gravels above modern floodplains. Modern streams in the Klondike area are filled with the erosional products of these gravels and local bedrock and are commonly overlain by dark fine grained organic alluvial sediments referred to as "muck".

The placer deposits of the Klondike District have been subdivided by McConnell (1905, 1907) into four categories (Fig. 3). From oldest to youngest they are: 1) high level terrace gravel (White Channel gravel); 2) high level river gravel (Klondike gravel); 3) intermediate river terrace gravel; and 4) stream gravel. Stream gravel deposits can be further subdivided into river, creek, and gulch deposits (Morison, 1989).

2 PLACER DEPOSIT EXPLORATION

As in hardrock mining, there are different stages in the exploration and development of a placer mining property. Generally speaking, preliminary or grassroots exploration (prospecting) is followed by more advanced exploration, ore reserve delineation, and ultimately mining. This report is mainly concerned with the use of light auger drilling for the prospecting stage. The aim of placer prospecting is to gain an initial evaluation of a property through reconnaissance type sampling, mapping, data collecting, and compilation. This includes the investigation of depth to bedrock, thickness of gravel, thickness of muck, gold values, approximate extent of the deposit, accessibility, and ground conditions.

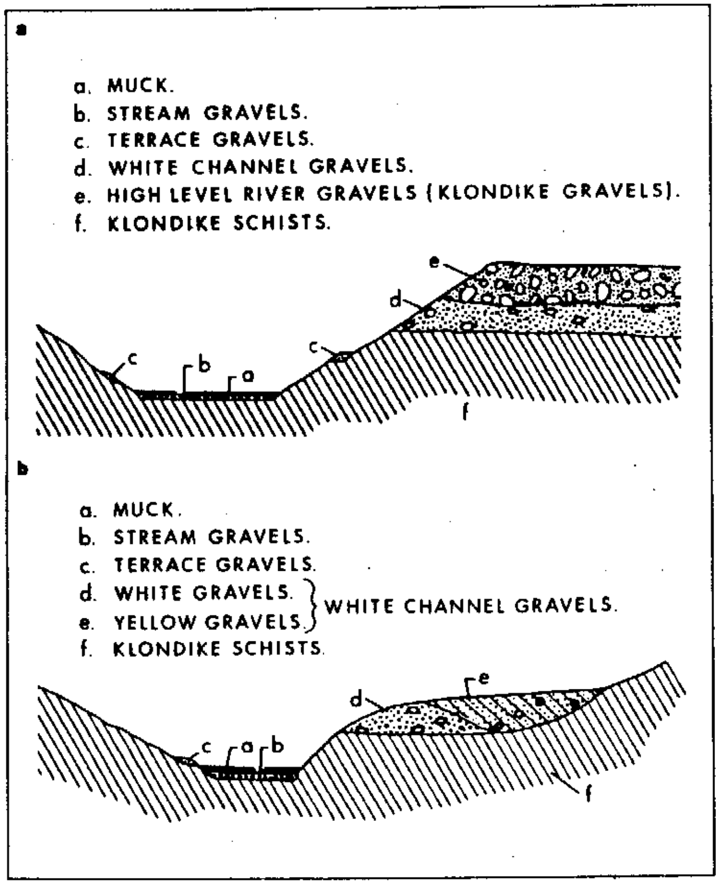


Figure 3: Classification of typical Klondike placer deposits, according to McConnell, 1907. Generalized sections across a) lower part of Bonanza valley and b) below junction of Bonanza and Eldorado valleys (Knight et al., 1994).

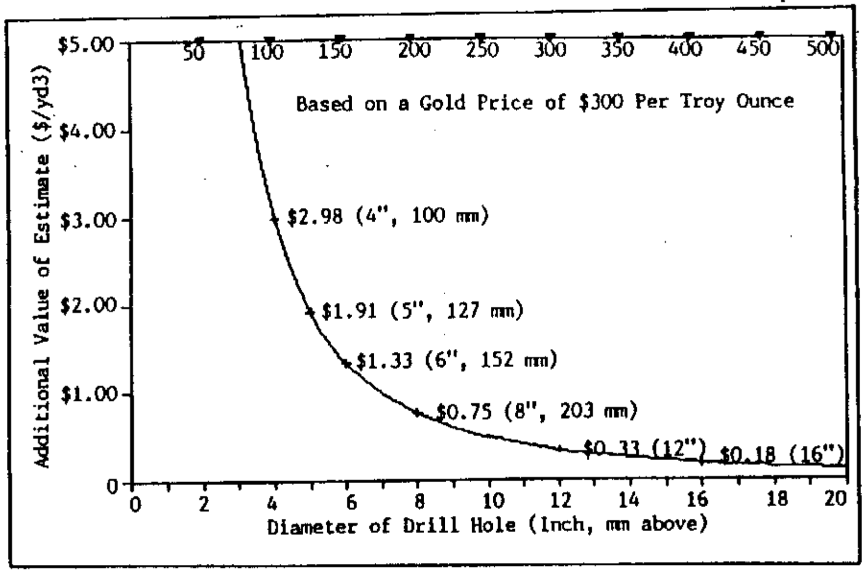


Figure 4: Sensitivity of drill hole size; effect of a 1 mg gold particle on the value estimate (from Clarkson, 1993).

2.1 Drilling

Drilling is one of several sampling methods used in the placer mining industry to determine mineable reserves. Other methods include exposure sampling, sinking shafts, excavating pits and trenching. Drilling is generally undertaken in frozen, deep or wet ground where pit and trench sampling is not practical (Debicki, 1983). Several types of drills are available and have been used extensively for placer exploration in the Klondike area. They include churn drills, sonic drills, hammer or percussion drills, reverse and normal circulation drills, and auger drills. Auger drills are particularly popular with Yukon placer miners because of their low cost, simplicity, and relatively rapid penetration rates in frozen gravels. They are best suited for drilling in frozen ground where the wall of the hole is somewhat consolidated by the competency of the material and its resistance to caving (Clarkson, 1993).

2.2 Auger Drilling

Auger drills are commonly used to block out orebodies in the advanced exploration stage. Such drills can also be a valuable tool in the reconnaissance exploration stage.

Auger drills utilize auger rods which are commonly 3 ft. (0.9 m) or 5 ft. (1.5 m) long steel rods with flights welded on in a spiral for the entire length of the rod segment. Augers are connected to each other through shanks and secured with U-pins. The lowest auger rod is fitted with the appropriate drill bit and is usually slightly larger than the diameter of the augers. Drilling action consists of a combination of auger rotation and downward pressure. Sediment migrates up the flights, eventually up to the collar of the hole which is sampled and processed for gold content and physical description.

Because of their light weight and construction compared to other drill types, auger drills are limited to drilling shallow holes (30-50 m) in sediments where clasts do not exceed cobble size (Clarkson, 1993). Another limitation of auger drilling is the incidence of contamination from loose material falling off the wall of the hole (or "annulus") and being displaced, even in frozen or semi-consolidated materials. Contamination is increased by repeated pulling out of augers as during interval sampling. Finally, loss of sample material is another concern in auger drilling, particularly with uncohesive or dry material.

An inverse relationship exists between the size of a drill hole and the accuracy or representativeness of its gold grade. Smaller drill holes are more sensitive to skewing of values by addition or omission of a gold particle, otherwise known as the "nugget effect" (Clarkson, 1993). The size of placer gold particles will also impact the representativeness of a sample. For instance, widely disseminated fine gold will give more homogeneous values, whereas larger particles concentrated in pockets or zones may result in erratic values. Figure 4 illustrates the effect of a 1 mg particle of gold on grade estimate. Holes with diameters less than 6 in. (15 cm) introduce a margin of error considered unacceptable for advanced ore grade calculations (Debicki, 1985 and Clarkson, 1993). Clarkson reports average net gold recoveries ranging from 62% to 81% for small to large auger drills with hole diameters exceeding 6 in. (15 cm). The larger the size of the hole, the more representative the grade estimate will be. However, large auger rods require large, heavy powerful drill rigs to drive them through placer deposits. Small diameter holes can be drilled with smaller lightweight drills in areas where accurate gold grade estimates are not a requirement, at the preliminary prospecting stage.

3 ATV DRILL SPECIFICATIONS

The ATV drill is a mast-supported lightweight hydraulic drill mounted on a modified 8-wheel Argo ATV (all terrain vehicle) (Plate 2). It is a modified prototype designed for scientific research and is not commercially available. Its specifications and expected performance are listed in Figure 5.

3.1 Mobility

The ATV drill rig is self-propelled by a 16 HP engine which also powers the drill. Ground manoeuvrability is somewhat restricted due to a long wheel base and a wide turning radius. It is equipped with eight tires (5 PSI) and can be converted to tracks. Maximum attainable speed is limited to 5 km/hr.

It can be transported on a 3 m long by 1.5 m wide trailer towed by a pick-up truck (Plate 3). The drill rig can also be disassembled by three people into two parts: mast + drill (600 lbs) and carrier (1400 lbs), for slinging by a Bell Long Ranger (206L) or a similar medium-size helicopter, in two loads.

3.2 Stability and Accessibility

The ATV drilling machine, with its mast supported in tilt position on a raised cradle, is relatively stable. When in operation, the mast is stabilized by two A rods

DRILL RIG SPECIFICATIONS

TOTAL WEIGHT (WITHOUT TOOLS):	Approx. 908 kg (2000 lbs)
ATV WEIGHT:	Approx. 636 kg (1400 lbs)
MAST AND DRILL WEIGHT:	Approx. 272 kg (600 lbs)
DIMENSIONS:	1.4 m wide x 3.2 m long x 1.0 m high (4.8' x 10.5' x 3.1')
MAST:	4.3 m (14') long, controlled by hydraulic cylinder
ATV ENGINE:	Tecumseh* 16 horsepower air-cooled 4 cycle engine.
POWER TRANSMISSION:	Powers both ATV and drill systems through hydraulic transmission.
DRILL TYPE:	Modified Winkie* GW-15 Unipress, JKS Boyles.
FEED SYSTEM:	Hydraulically driven chains.

EXPECTED DRILL PERFORMANCE

FEED (DOWNWARD PRESSURE)	1140 kg (2500 lbs)
MAX PENETRATION RATE	15 m/ hr (50'/ hr)
RETRACTING RATE	3-4.6 m/minute (10-15'/minute) [with rotation]
HOISTING CAPACITY	910-1140 kg (2000-2500 lbs) @ 12-15 m/minute (40-50'/minute)
RANGE OF BORING SPEED	30-1100 RPM
TORQUE	40-550 ft. lbs

*Brand Name

Figure 5: ATV drill rig specifications and expected drill performance.

Plate 3: Driving the ATV drill onto a trailer during demobilization.

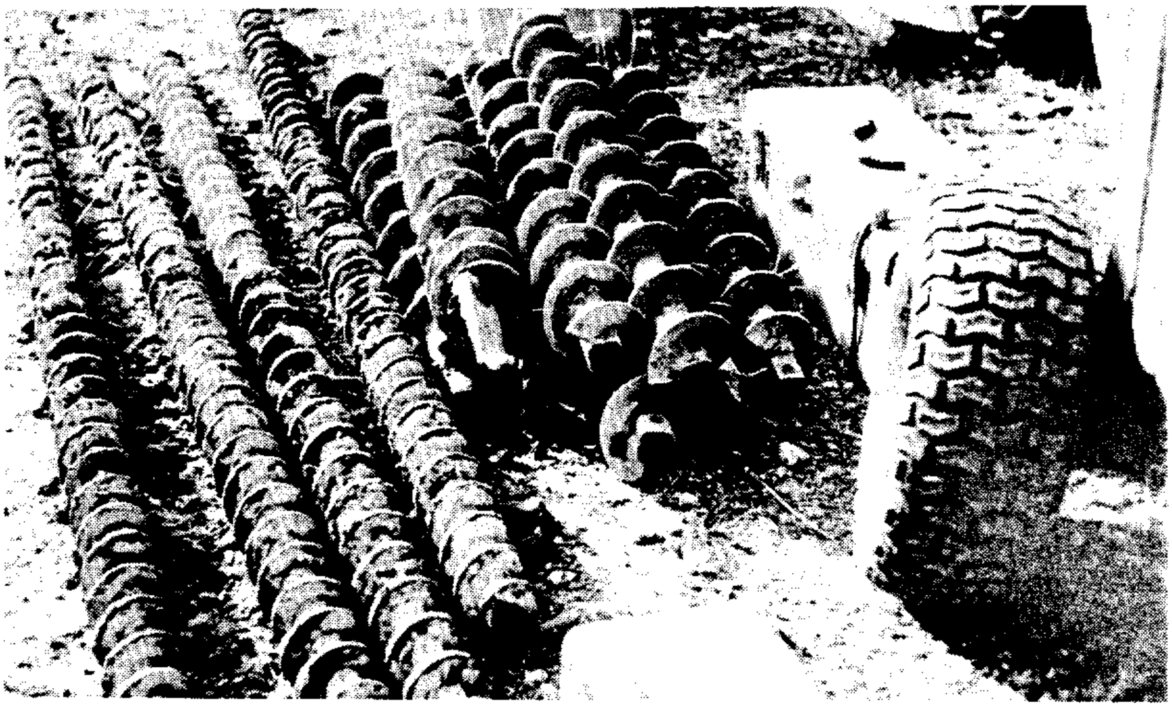


Plate 4: Drill augers: 3 in. (left) and 4 in. (right) diameter (3 ft. long rods).

attached to the top. Vehicle stability is attained by stabilizing jacks and screw anchors.

It can climb slopes of up to 20°, traverse shallow water bodies, wet snow up to 50 cm deep (with tracks), hummocky muskeg, and rugged arctic terrain. However, accessible terrains are limited by the low clearance of 14 cm (5.5 in.) at the front end and 19 cm (7.5 in.) at the back end of the ATV.

3.3 Drill Equipment

Auger drilling requires an assortment of drilling equipment and tools in addition to the drill rig. The basic equipment used on this project include augers, drill bits, and core sampling barrels.

The three types of augers used on this project are: (Plate 4)
1) 3 in. (7.6 cm) diameter - $^{13}/_{16}$ in. (2.1 cm) shank hexagonal 3 ft. (0.9 m) long augers
2) 4 in. (10.2 cm) diameter - 1 in. (2.5 cm) shank square 3 ft. (0.9 m) long augers
3) 4 in. (10.2 cm) diameter - $1^{1}/_{8}$ in. (2.9 cm) shank hexagonal 5 ft. (1.5 m) long augers.

Drill bits used on 3 in. (7.6 cm) augers include 3.5 in. (8.9 cm) fishtail, prong, and finger bits (Plate 5). The fishtail bits work best in fine material (fine gravel, sand, silt, clay), whereas the prong bit is best suited for fine to medium size gravels and fine sediment sequences. The finger bit was not as efficient in any of the surficial materials encountered.

Drill bits used on 4 in. (10.2 cm) augers include the 4.5 in. (11.4 cm) fishtail and bulldog bits (Plate 6). The fishtail bit is used for material as coarse as pebbly sand. The bulldog bit is used in gravel with clasts as large as medium-size cobbles (up to 10 cm).

Two types of core sampling equipment were also tested out at one drill site (Site C). Unlike a drill bit which disturbs drilled material, these core barrels can retrieve a relatively undeformed sample.

The 3 in. (7.6 cm) CRREL (Cold Regions Research Engineering Laboratory) core barrel, designed by the United States Army Corps of Engineers, consists of a steel core barrel with a welded double helix flight (Plate 7). A steel cutting shoe fastens to the bottom of the barrel. The cutters, made of steel and tungsten carbide, are fastened to the shoe. The CRREL core barrel works best in frozen fine grained organic and mineral soils (clay, silt, sand) (Veillette and Nixon, 1980).

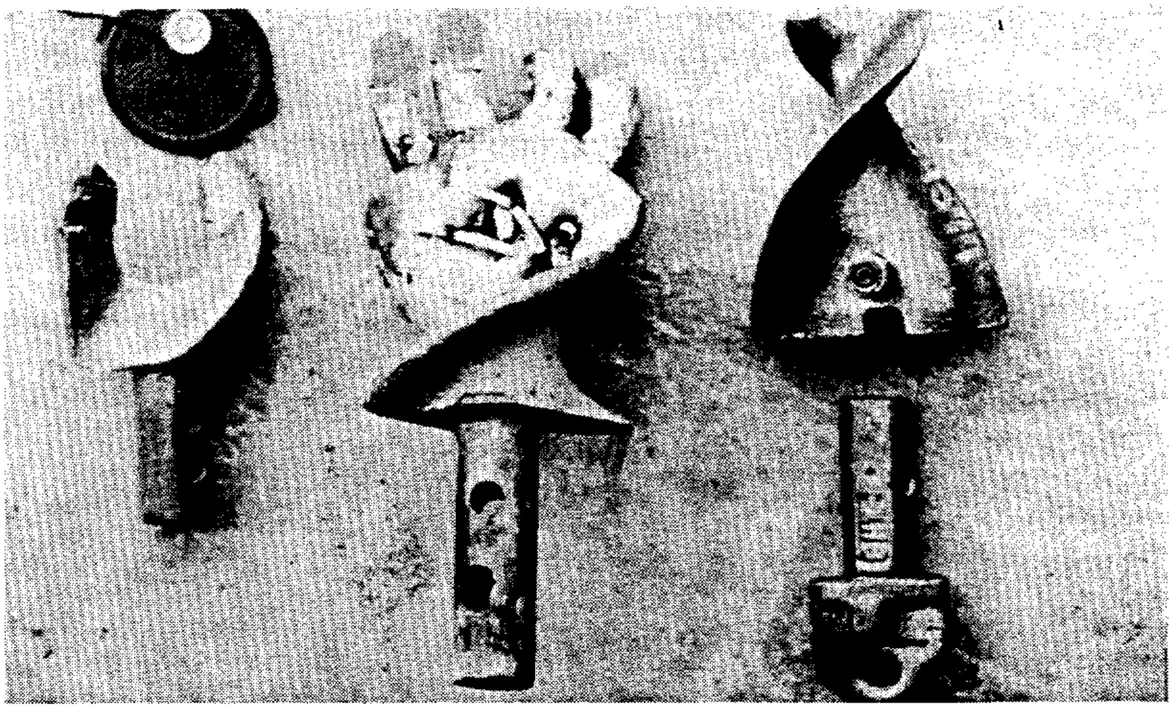


Plate 5: Drill bits used on 3 in. augers: prong bit (left), finger bit (center), and fishtail bit (right). Lens cap for scale.

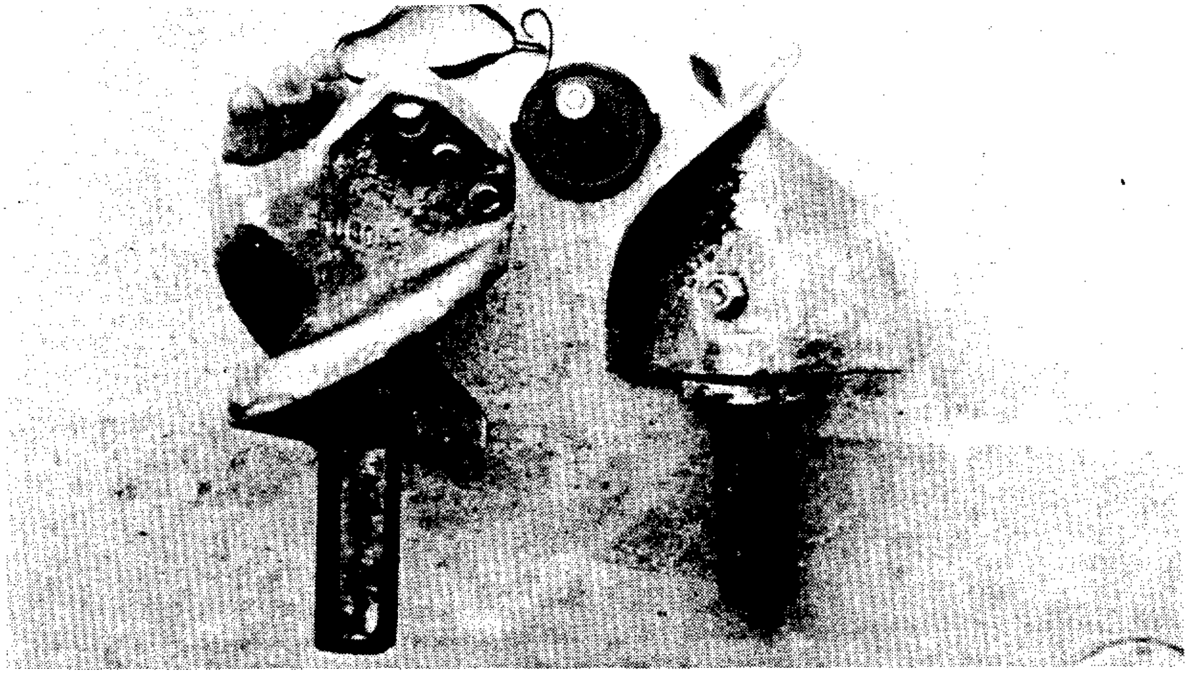


Plate 6: Drill bits used on 4 in. augers: bulldog bit (left) and fishtail bit (right).

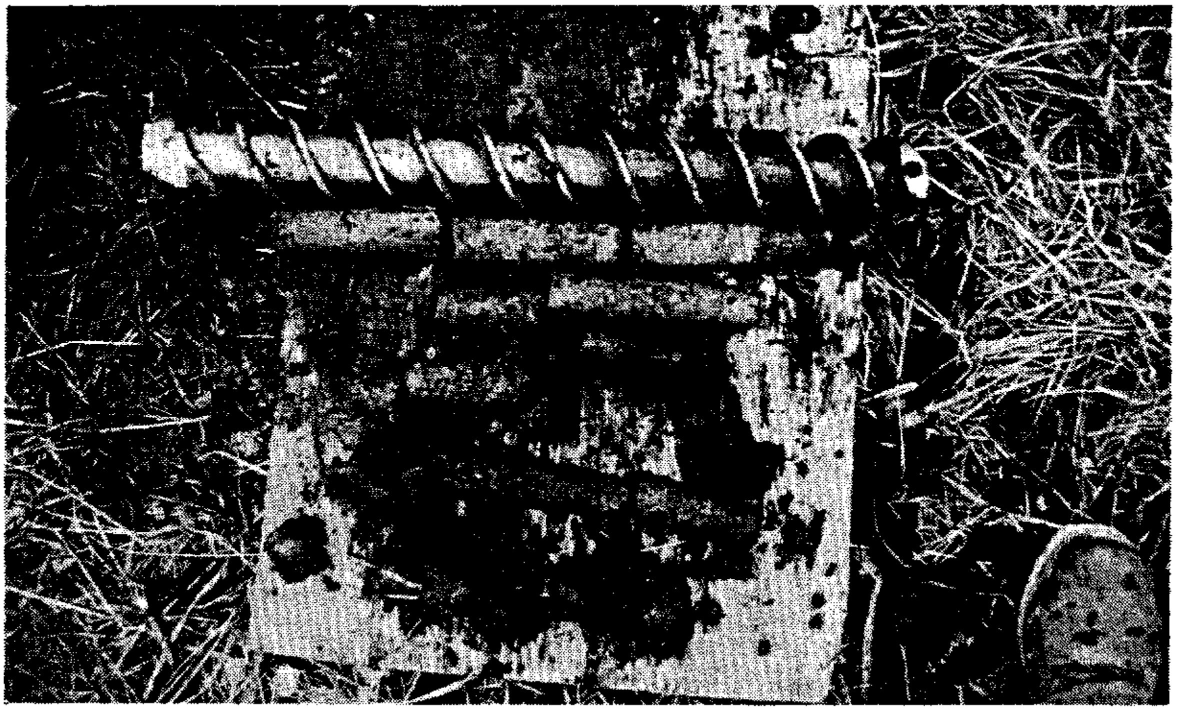


Plate 7: CRREL core barrel (diameter: 7.6 cm, length: 25 cm) used to retrieve frozen muck sample.

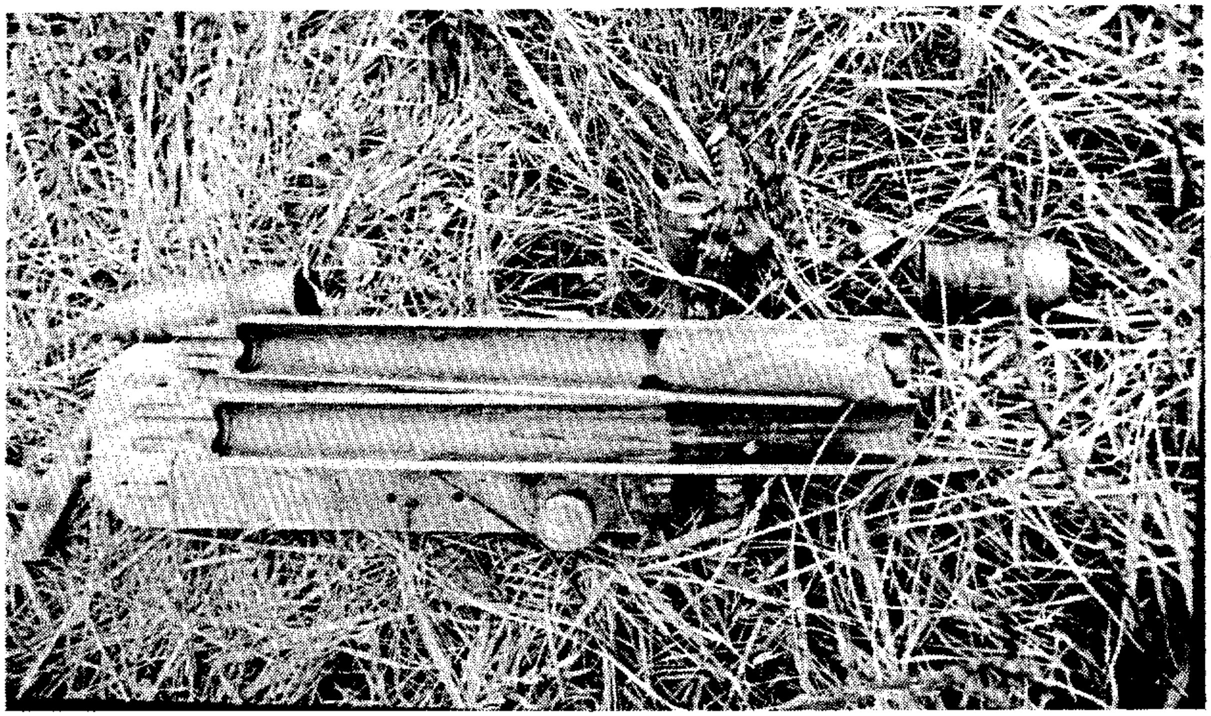


Plate 8: Split tube core barrel (diameter: 5.1 cm) with frozen muck sample.

The 2 in. split tube (or split spoon) sampler consists of a barrel which opens in two halves to retrieve the core sample (Plate 8). Unlike the CRREL corer, it requires a drive sampling mechanism which uses a drop hammer (weighing 63.5 kg), activated by the cat head winch via rope and sheave hung from the top of the mast. Drive sampling works best in unfrozen fine material (clay, silt, sand) or partially frozen material, warmer than -5^0 C (Veillette and Nixon, 1980).

4 METHODOLOGY

Drilling was undertaken in both previously drilled gravel (five sites) and undrilled (five sites) ground on active mining properties. This allowed for drill hole duplication of "twinning" and comparison with previously established drill results. The sites were chosen based on a number of factors including depth to bedrock, gravel characteristics, ground thermal conditions, previous work, and permission from the mining property owner. Holes were drilled until "refusal " (a state of stagnant or very slow ground penetration), bedrock, or a maximum depth of 36 ft. (11 m) which was suggested as a maximum recommended depth for the ATV drill rig under the conditions encountered. Each completed hole was blocked with a long stick, labelled and flagged. Drill site locations were determined from 1:50,000 scale topographic maps (115O/10, 115O/14, and 116B/3).

1. Samples were collected at 3 ft. or 5 ft. intervals (depending on the length of auger rods) or whenever a change in unconsolidated sediment was encountered. Once the auger rods were pulled out of the drill hole, the bottom two flights were sampled. Each sample was collected in 20 L (5 gallon) plastic buckets and labelled (Plate 9). Sample volume was estimated as a fraction of a bucket.

2. For each drill hole the stratigraphy, including permafrost conditions, was described as a written and graphic log form, based upon examination of drilled material (Plate 10).

3. Samples which were granular (anything from granular muck to gravel, including weathered or fractured bedrock) were set aside for further processing by repeated washing, thereby eliminating silt and clay (Plate 11).

4. The washed samples were then panned in a washtub. The resulting concentrate was described and collected (Plate 12). A lithological description for the coarse tailings was given for each panned sample.

5. Gold particles were extracted from the dried heavy mineral concentrate and weighed to the nearest hundredth of a milligram. The grade was estimated by calculating the milligrams of gold per sample volume and converting to oz/yd^3.

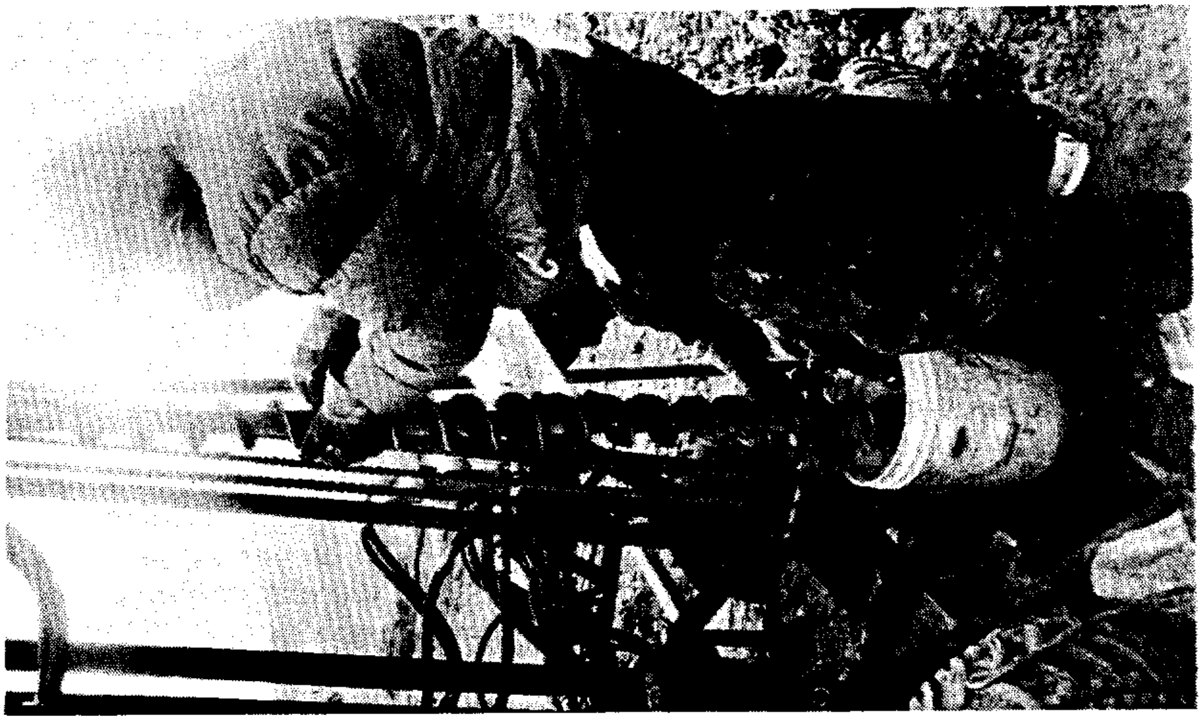


Plate 9: Collecting a sample from augers.

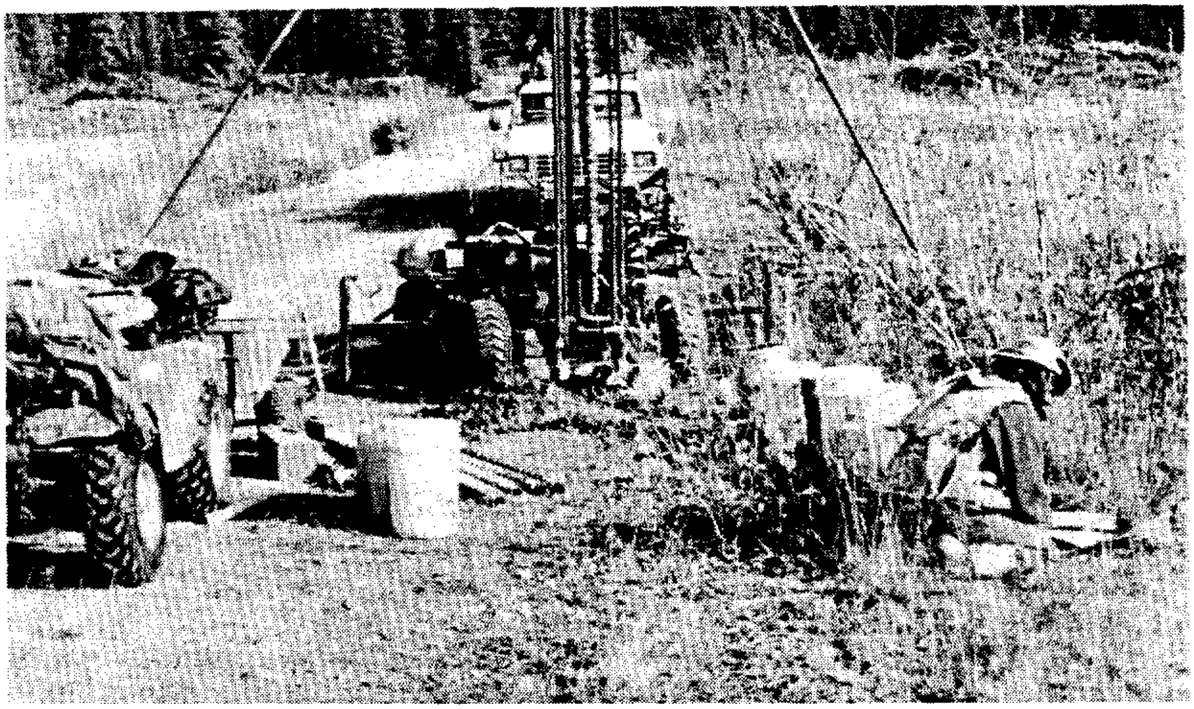


Plate 10: Stratigraphic logging of drill hole.

Plate 11: Washing drill samples.

Plate 12: Panning drill samples.

5 PROBLEMS

5.1 Equipment

The drill project was plagued by mechanical problems resulting in below par drill performance, compounded by a limited supply of (used) drilling equipment. The mechanical problems are attributed to the fact that the ATV drill rig is a twenty year old prototype which has been subjected to many seasons of drilling and several modifications. The ATV drill is on loan to the Geoscience Office by the Geological Survey of Canada.

5.2 Drilling

Drilling through frozen muck was problematic, as the augers had to be pulled out frequently, about every 0.5 ft. to 1 ft. (15-30 cm), to unclog muck from the bit. This caused enlargement of the hole. Clogging was not a problem with the use of the CRREL core barrel. However, samples are generally less than 50 cm (20 in.) long because the core barrel is only 64 cm (25 in.) long. Hammer sampling using the split tube barrel was also inefficient for drilling in frozen muck.This method was abandoned after very slow or non-penetration compared to the CRREL corer. Hammer sampling is also considerably more labour intensive.

Drilling through unfrozen sand to gravel resulted in considerable contamination, hole enlargement, and poor sample recovery. This problem was accentuated by high water content, particularly near or at the water table.

Refusal took place when the drill bit encountered a large cobble, boulder or bedrock. Unless information regarding depth to bedrock was available, it was difficult to assess, with certainty, the nature of the material drilled at refusal.

5.3 Sampling

Because of the delay involved in sample recovery and the physical disruption of the sample when auger drilling, accurate depth determination of subtle stratigraphic changes was difficult to assess. Frequently, the last drilled material on the auger flights was enveloped with a rim (up to 1 cm thick) of contamination material derived from the walls or from material higher up along the hole. This introduced a significant contamination factor which was excluded in the stratigraphic description but was inevitably included in the sample. To reduce the risk of contamination and reduce the uncertainty of the origin of the material sampled and logged, only the bottom two flights were sampled. Unfortunately, this made for small samples which generally varied between 3-20 litres (less than a 20 L or 5 gallon bucket). It is a well-known fact that in any sampling program, larger samples are more representative and are generally preferable. However, the purpose of this study was more of a preliminary testing nature than a systematic testing of placer mining ground.

Interval sampling, which required pulling out augers for each sampling interval, is by nature more disruptive than continuous (uninterrupted) sampling. Some of the commercial placer drilling in the Klondike is done by continuous sampling which involves drilling continuously until bedrock is reached before pulling up the augers and collecting only one large sample. This type of sampling is undertaken when it is assumed that most of the gold is located at the gravel-bedrock interface. Although it minimizes the chance of sample contamination, this method does not allow for stratigraphic logging.

5.4 Stratigraphic Logging

Stratigraphic logging of drill holes based on materials recovered from the augers is somewhat misleading. Because the augers flights are limited to carrying clasts not exceeding pebbles and small cobbles and because gravel size clasts tend to fall off the augers while migrating upwards, samples collected at the surface tend to be skewed towards the finer fraction of the original drilled material. The greater cohesiveness of finer material such as sand, silt, and clay over that of gravel also increase the proportion of fines in the sample as they tend to preferentially stick to the augers. Unless there exists a mined cut or exposed face of the surficial material being drilled to allow for correlation, the drill cutting will misrepresent the gravel as being finer than it actually is. Boulders will go unnoticed unless they are intersected by the drill, resulting in refusal. These problems are intrinsic to auger drilling in general.

6 DRILL PERFORMANCE

The ATV drill was subjected to considerable stress in order to test its capabilities and limitations. Penetration rates were assessed in different surficial materials with a limited variety of drill bits.

6.1 Carrier

Because of road access to many drill sites and the absence of overly rugged terrain, the ATV carrier was capable of accessing all chosen sites. The modified stretched out wheelbase decreases its mobility and manoeuvrability compared to a regular 8-wheel ATV. Its low clearance (14 cm) is problematic in areas where the microtopography is of sufficient relief and ruggedness to cause the vehicle to become high centered.

6.2 Drill

Figure 6 is a summary of penetration rates in different materials using both 3 in. (7.6 cm) augers and 4 in. (10.2 cm) augers, with new and used bits. These penetrations rates include pulling out augers every 3 ft. to 5 ft. (0.9 to 1.5 m) intervals or less for sampling purposes and changing drill bits when required. Because of recurrent mechanical problems, penetrations rates were difficult to assess accurately and should be regarded as estimates.

The fastest drilling (33 ft./hr or 10 m/hr) took place in unfrozen, moist loose muck, using a new fishtail bit. Within unconsolidated material, penetration was slowest (3 ft./hr or 0.9 m/hr) in frozen sandy pebble/cobble gravel, using a bulldog bit. Drilling through well consolidated bedrock is by far the slowest, as it approaches the state of refusal. Continued drilling through such bedrock with bits designed for unconsolidated material is not recommended and will lead to bit grinding.

Drilling penetration is mainly influenced by four properties of the material drilled: 1) extent of freezing; 2) clast size; 3) distribution of clast size; and 4) degree of cohesiveness. All else being equal, frozen materials are more difficult to penetrate than unfrozen materials. Generally, coarser materials are slower to drill through than finer materials. The concentration of clasts is another important factor in determining drilling rates. A gravel with a high percentage of matrix will be easier to drill than one with a low matrix percentage, as the drill is better able to push aside the large clasts and get through the finer material. Finally, an increase in the degree of cohesiveness will lead to slower drilling. Uncohesive material such as well sorted sand will be quick and easy to drill through whereas a highly cohesive muck, characterized by a high clay and silt content will lead to slow penetration rates as well as clogging and sticking.

PENETRATION RATES

For 3" Augers:

MATERIAL	FISHTAIL BIT	PRONG BIT	CRREL CORER
Frozen muck	N/A	N/A	6'/ hr
Frozen silt, granular silt, clay gouge	N/A	5'/ hr (used)	N/A
Unfrozen pebbly/granular sand	N/A	4-8'/ hr (used)	N/A

For 4" Augers:

MATERIAL	FISHTAIL BIT	BULLDOG BIT
Unfrozen muck	33'/ hr (new)	N/A
Frozen muck and granular muck	12'/ hr (new)	N/A
Frozen and unfrozen muck	6'/ hr (used)	N/A
Frozen muck	5'/ hr (used)	N/A
Unfrozen sand to granular sand	16'/ hr (used)	N/A
Frozen gravelly sand and silt	3'/ hr (used)	3-7'/ hr (new)
Unfrozen loose pebble/cobble gravel	10'/ hr (used)	N/A
Frozen sandy pebble to cobble gravel	N/A	3'/ hr (used)
Bedrock (rate depends on competence)	N/A	<1'/ hr (used)

N/A = NOT AVAILABLE

"Used and "New" refer to the state of the drill bit.

Figure 6: Penetration rates for 3 in. and 4 in. augers through frozen and unfrozen material using different drill bits.

7 RESULTS

Figure 7 summarizes the basic results for each drill hole. A total of twenty-three holes were drilled: twelve reached bedrock and thirteen were gold bearing. Due to the confidential nature of drilling on active placer mining properties, absolute gold values cannot be released; however, the presence or absence of gold is stated for each hole. Drill hole depth ranged from 9 ft. to 36 ft. (2.7 to 11 m). For comparison purposes, eleven drill holes were twinned with holes previously drilled with larger drill rigs (≥6 in. diameter holes). Where results from previous drilling were available, our gold values were compared in terms of the ratio between gold values obtained from our drilling versus those obtained from previous drilling over a common interval (Fig. 7). The following formula was used to calculate this ratio:

$$\text{Ratio of Gold Values} = \frac{\text{ATV Drill Result } (oz/yd^3)}{\text{Prev. Drill Result } (oz/yd^3)}$$

Ratios exceeding 1 indicate greater gold recovery from ATV drilling than previous drilling; ratios less than 1 indicate poorer gold recovery from our drilling. Our work shows erratic recovery of placer gold which is due to a number of factors:

1) the nugget effect
2) the inherit variability of placer gold by concentration distributed in an irregular manner
2) the small number of test sites
3) ATV drill holes were drilled next to and not directly through previous drill holes
4) contamination due to interval sampling
5) small sample size.

Results (Fig. 7) are inconclusive for establishing any systematic correlations between our drilling and larger diameter drilling. These ratios are approximations which are meant to provide preliminary numbers for comparison drilling. However, the ATV drill returned gold from 5 out of 6 twinned drill holes which are known to be gold-bearing from previous drilling. The single non-gold bearing hole was drilled in an area disturbed by previous workings. Therefore, the 4 in. (10 cm) ATV drill retrieved gold in virtually every hole drilled by larger drilling machines, even in low grade holes, which would satisfy the objective of a prospecting program. It also worthy of note that gold was retrieved from higher up in the gravel stratigraphy which was not sampled by previous drilling.

7.1 Gold Characteristics

Thirteen holes out of twenty-three contained gold. Out of a total of 80 panned samples, 20 were gold bearing. A variety of gold particles of different sizes and

DRILL RESULTS

DRILLHOLE	DEPTH (')	DEPTH (M)	BEDROCK?	GOLD?	Ratio of Gold Values
A-1	18.0	5.5	Y	N	
A-2	9.0	2.7	N	Y	
B-1*	36.0	11.0	N	N	No gold
C-1*	21.0	6.4	N	Y	N/A
C-2*	23.0	7.0	N	Y	N/A
C-3*	20.5	6.2	N	Y	N/A
D-1*	29.3	8.9	Y	N	0 over 7' (2.1 m)
D-2*	27.0	8.2	Y	Y	1.2 over 14' (4.3 m)
D-3*	28.5	8.7	Y	Y	0.4 over 5' (1.5 m)
D-4*	30.0	9.1	Y	Y	0.1 over 8' (2.4 m)
E-1	29.0	8.8	N	Y	
F-1	21.0	6.4	N	Y	
F-2	21.0	6.4	N	N	
G-1*	10.0	3.0	Y	Y	N/A
G-2**	13.0	4.0	Y	N	
H-1*	12.5	3.8	N	Y	N/A
H-2*	31.0	9.4	Y	Y	1.7 over 4' (1.2 m)
H-3	20.0	6.1	Y	N	
H-4	22.0	6.7	Y	N	
I-1	35.5	10.8	Y	Y	
I-2	33.0	10.1	Y	N	
J-1	15.0	4.6	N	N	
J-2	19.3	5.9	N	N	

* Twinned holes
** Drilled between 2 holes

Y=YES
N=NO
N/A= NOT AVAILABLE

Figure 7: Basic drill results indicating depth of drill hole, presence or absence of bedrock and gold, and ratio of gold values of ATV drilling over gold values of previous established drilling.

shapes were retrieved by the ATV drill. Most of the gold was flat and ranged from 0.1-2 mm in diameter and 0.1-0.4 mm in thickness. The best sample produced 10 mg (17 specks) of gold over a 3 ft. interval. The best hole produced 16 mg of gold over an 8.5 ft. interval. Gold particles occur as angular to rounded, pitted and scratched flakes displaying a variety of shapes which fit into all four main shape classifications (according to Knight et al, 1994): equant, elongate, complex, and branched (Plate 13, 14).

8 STRATIGRAPHY

The ten drill sites are all located within alluvial placer deposits and include high level terrace placers (White Channel and Klondike gravel) [2 sites], river terrace placers [2 sites], and stream placers [6 sites]. Most of the sites are stream placers which can be further subdivided into: 1) creek deposits [5 sites] and river deposits [1 site].

Stratigraphic descriptions for each drill hole are summarized in Figures 10 to 31. Figure 8 is a legend of the stratigraphic patterns illustrated in the graphic drill logs. Grain size analysis of selected matrix samples can be found in the Appendix. Lithological terminology is based on Folk's (1954) sediment classification (Fig. 9). Colour identification is based on the Munsell Soil Colour Charts (1990), except where colours fall outside the range of Munsell soil colours. Matrix is defined as any material less than 2 mm and includes sand, silt, and clay. Gravel is defined as any clast exceeding 2 mm. Grain size categories are stated in the legend (Fig. 8).

8.1 High Level Terrace Placers

8.1.1 Site A - Gumbo Hill (2 holes)

Site Description: This site is located on one of the hills, approximately 50 m (164 ft.) above valley bottom, on the west side of Last Chance Creek, adjacent to 8 Above Pup. The site has been stripped of vegetation and forms a relatively flat bench on an ESE facing hillside. The material is well drained, dry and unfrozen. This part of the hill is currently being mined by Lokey Mining Services. A mining cut is located adjacent to the drill site (Plate 14). The following stratigraphic description is mainly derived from this cut rather than strictly from drilling because the former was more informative.

Site Geology: Local bedrock includes both dark brown weathering micaceous mudstone and dark grey graphitic schist. The top portion of bedrock exposure is marked by a dark brown friable surface weathered to

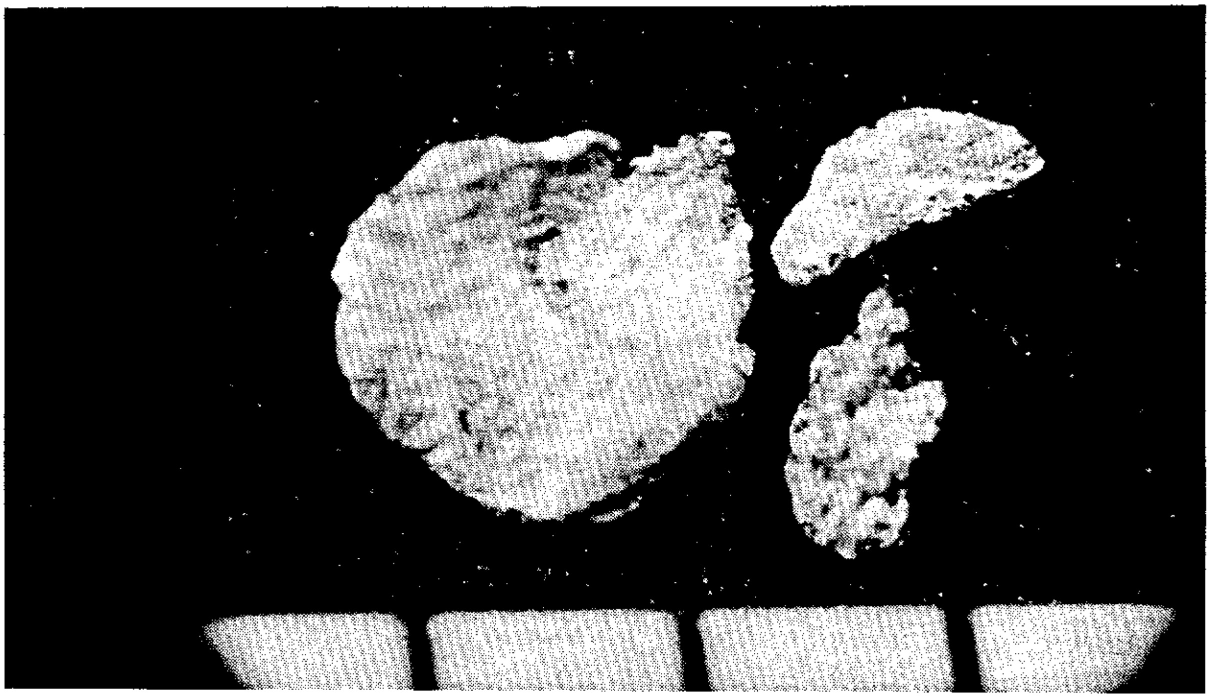


Plate 13: Equant, elongate, and complex gold particles (scale is 1 mm).

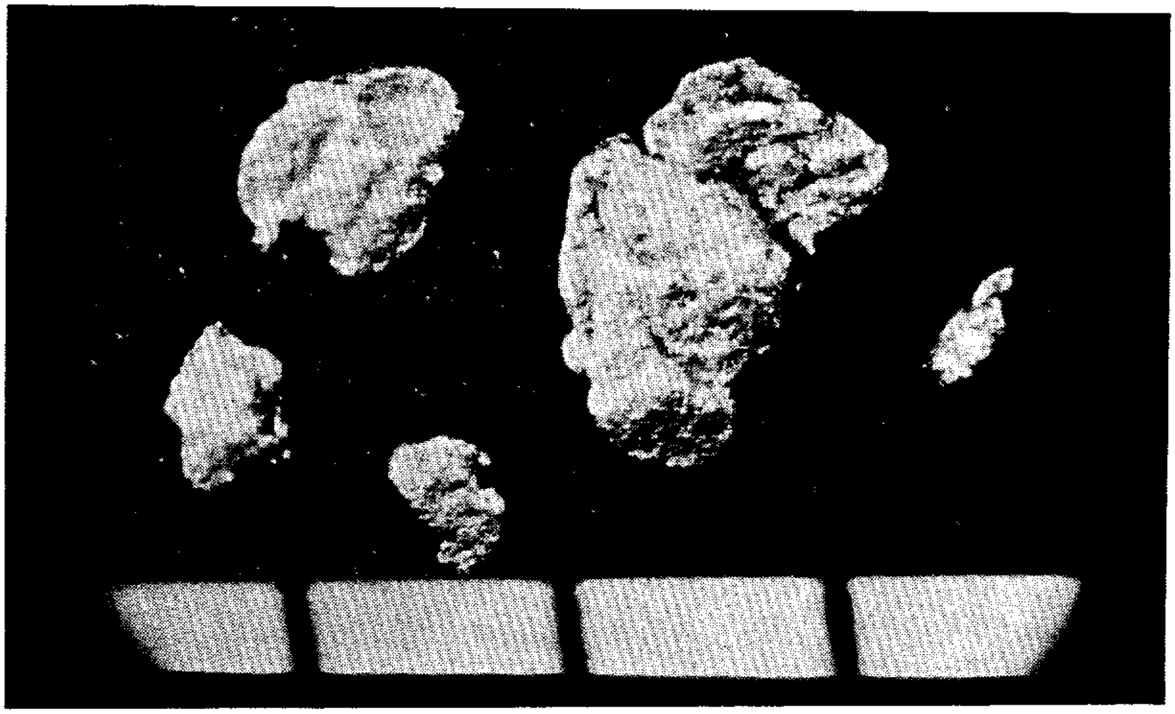
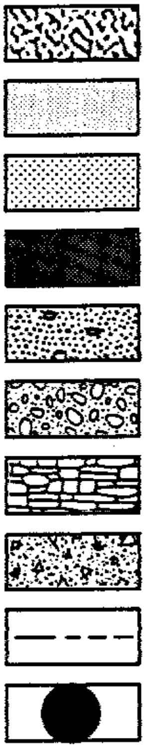


Plate 14: Complex and elongate gold particles (scale is 1 mm).

LEGEND OF STRATIGRAPHIC PATTERNS



Organic material (peat, humus)

Silt, sandy silt

Sand, silty sand

Muck (organic mixture of silt, fine sand, and clay)

Gravelly or slightly gravelly sand, silt or mud

Gravel, muddy gravel, muddy sandy gravel or sandy gravel

Bedrock or weathered bedrock

Colluvium

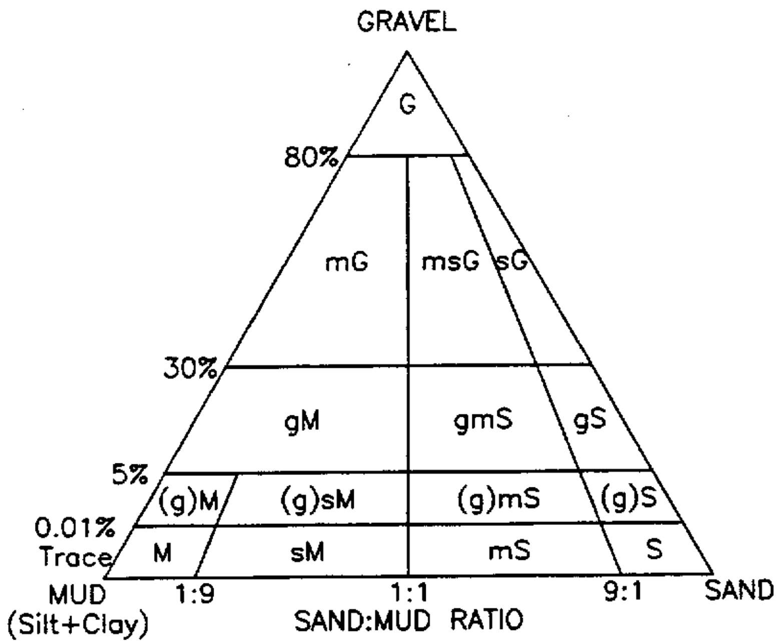
Stratigraphic contact (sharp, gradational)

Gold present

GRAIN SIZE CLASSIFICATION

Clay		$< {}^1/_{256}$
Silt		${}^1/_{256}$ - ${}^1/_{16}$ mm
Sand		${}^1/_{16}$ - 2 mm
Gravel:	Granule	2 - 4 mm
	Pebble	4 - 64 mm
	Cobble	64 - 256 mm
	Boulder	> 256 mm

Figure 8: Legend of stratigraphic patterns used in graphic drill logs and grain size classification. Large dots indicate the presence of gold within particular intervals.



G	Gravel
sG	Sandy gravel
msG	Muddy sandy gravel
mG	Muddy gravel
gS	Gravelly sand
gmS	Gravelly muddy sand
gM	Gravelly mud
(g)S	Slightly gravelly sand
(g)mS	Slightly gravelly muddy sand
(g)sM	Slightly gravelly sandy mud
(g)M	Slightly gravelly mud
S	Sand
mS	Muddy sand
sM	Sandy mud
M	Mud

Figure 9: Classification of sediments according to Folk (1974). Mud which contains greater than or equal to twice as much silt as clay is labelled as silt; mud which contains greater than or equal to twice as much clay as silt is labelled as clay. An intermediate proportion of silt and clay is labelled as mud.

Plate 15: Mining cut at Gumbo Hill showing pebble/cobble gravel over bedrock.

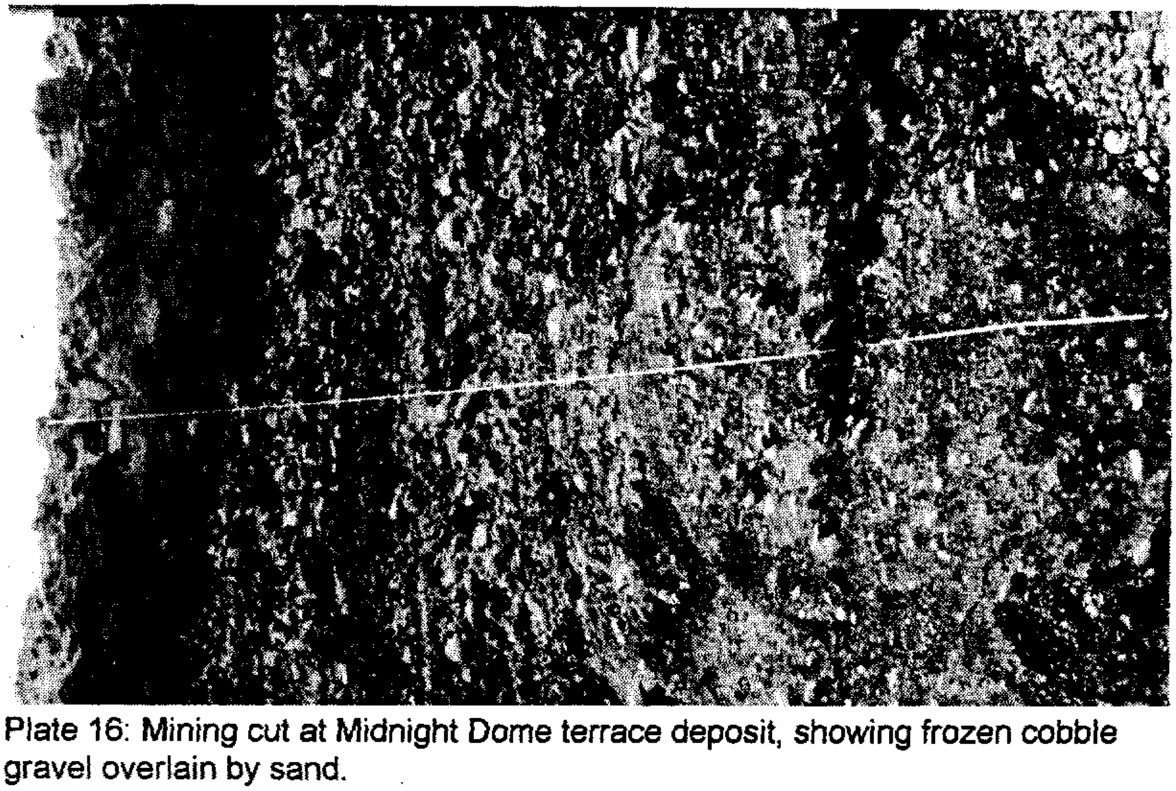


Plate 16: Mining cut at Midnight Dome terrace deposit, showing frozen cobble gravel overlain by sand.

silt and sand size grains. Bedrock is approximately 15 ft. (4.6 m) deep.

Bedrock is overlain by 12 ft. (3.6 m) of generally dry, tan coloured dry to moist White Channel cobble gravel (Fig. 10, 11). This gravel may be further subdivided into 3 sub-units: a basal (4.6 ft. or 1.4 m thick), middle (2.3 ft. or 0.7 m thick), and upper (3.3 ft. or 1 m thick) unit. The basal unit consists of a rusty (oxidized) tan coloured clast supported, sand matrix filled cobble gravel with clay skins. Quartz and micaceous quartzofeldspathic clasts are imbricated indicating flow towards the SE. The middle sub-unit is a tan coarse pebble clast supported, sand matrix filled gravel with some cobbles, and local clay skins. Clasts are angular to subrounded and include similar lithologies as the underlying sub-unit. The upper sub-unit is a tan coloured bleached clast supported, fine sand matrix filled cobble gravel with interstratified reddish brown (oxidized) layers up to 5 cm thick. Clasts are subangular to subrounded. The White Channel gravel is capped by 4.5 ft. (1.4 m) of reddish brown, strongly iron stained, clast supported, coarse sand matrix filled cobble gravel (Morison, 1985). However, drilling did not intersect this gravel. Clasts are subangular to subrounded. Stratification of this gravel may be anthropogenic. Contact with the underlying White Channel gravel is sharp.

8.1.2 Site J - Midnight Dome (2 holes)

<u>Site Description</u>: This site is located 1.5 km up the Midnight Dome road, 110 m (360 ft.) above Dawson City, on a south facing bench. The area is currently being mined and has been stripped by Torgold Mining. No vegetation is present near the drill site. The area is dry and well drained on surface but frozen at depth. The drill holes are situated adjacent to a mining cut which is the main source for the following stratigraphic description. The cut face mainly consists of frozen gravel overlain by sand (Plate 16). The frozen state of the gravel maintains material competency along the face but thawing lead to wall collapse along the cut.

<u>Site Geology</u>: Bedrock was not reached by drilling but is exposed at the base of the mining cut at a depth of about 40 ft. (12.2 m). It is a medium green, foliated mafic (andesitic ?) altered metavolcanic rock.

Bedrock is overlain by a 3 ft. (0.9 m) covered interval of gravel talus (Fig. 12, 13). Immediately above this talus apron is a 16 ft. (4.9 m) thick brown, openwork cobble gravel which loosens easily upon thawing. This unit is overlain by a 15 ft. (4.6 m) thick light to medium brown clast supported sand matrix filled cobble gravel with subrounded to rounded competent clasts.

DRILL HOLE: A-1 MAP: 115O/14 NTS: 591700 E

LOCATION: GUMBO HILL HOLE DIAMETER: 4" ELEV: 1755' 7097158 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-6'	Gravelly Silty Sand	Yellowish brown - 10YR5/6	10-20	4 cm
6-12'	Gravelly Silty Sand	Yellowish brown - 10YR5/6	10	6 cm
12-15'	Gravelly Silty Sand	Olive Brown - 2.5Y4/3	10	4 cm
15-18'	Bedrock - Graphitic Schist	Dark Olive Brown		

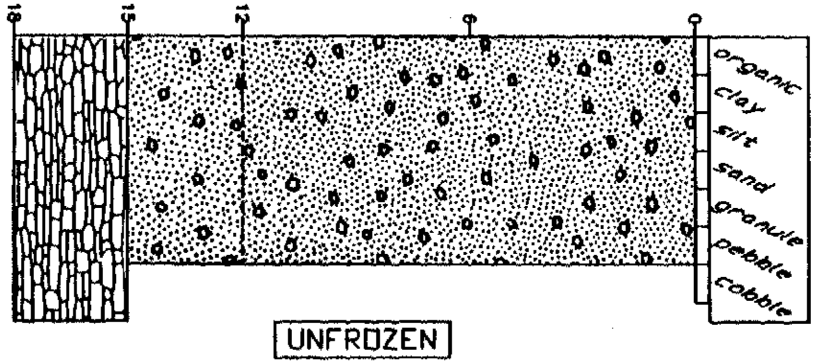


Figure 10: Stratigraphic log of drill hole A-2 (Gumbo Hill)

DRILL HOLE: A-2 | MAP: 115O/14 | NTS: 591706 E

LOCATION: GUMBO HILL | HOLE DIAMETER: 4" | ELEV: 1750' 7097167 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Gravelly Silty Sand	Dark Yellowish Brown - 10YR4/4	15	1 cm
3-6'	Gravelly Sand	Light Olive Yellow - 2.5Y6/6	20	3 cm
6-9'	Gravelly Sand	Light Yellowish Brown - 2.5Y6/4	20	3 cm
9'	Refusal			

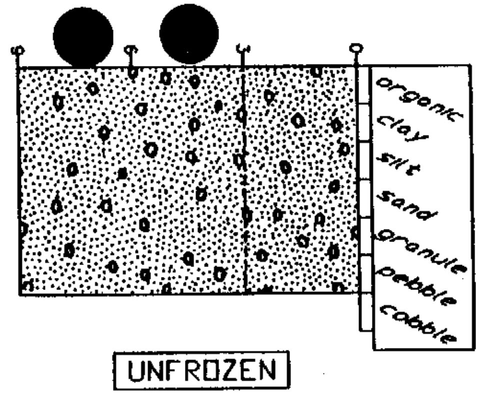


Figure 11: Stratigraphic log of drill hole A-2 (Gumbo Hill)

DRILL HOLE: J-1 | MAP: 116B/3 | NTS: 577700 E
LOCATION: MIDNIGHT DOME | HOLE DIAMETER: 4" | ELEV: 1410' 7103400 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-7'	Silt	Dark Olive Brown - 2.5Y3/3		
7-8'	Gravelly Silt	Very Dark Greyish Brown - 2.5Y3/2	5-10	4 cm
8-10'	Gravelly Silty Sand	Light Olive Brown - 2.5Y5/4	10-20	2 cm
10-15'	Silty Sandy Gravel	Olive Brown - 2.5Y4/3	40-50	5 cm
15'	Refusal			

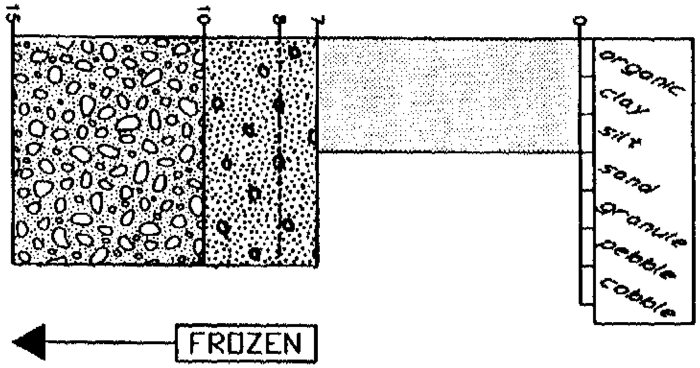


Figure 12: Stratigraphic log of drill hole J-1 (Midnight Dome)

DRILL HOLE: J-2 | MAP: 116B/3 | NTS: 577750 E
LOCATION: MIDNIGHT DOME | HOLE DIAMETER: 4" | ELEV: 1410' 7103375 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-10'	Silty Sand	Olive Brown - 2.5Y4/3		
10-15'	Sandy Mud	Very Dark Greyish Brown - 2.5Y3/2		
15-18'	Sandy Silt	Brown - 10YR4/3		
18-19.25'	Gravelly Silty Sand	Brown - 10YR4/3	20	4 cm
19.25'	Refusal			

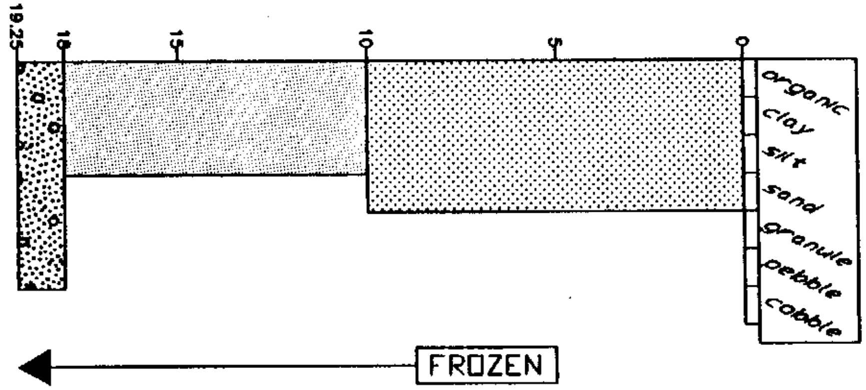


Figure 13: Stratigraphic log of drill hole J-2 (Midnight Dome)

This gravel is moderately well stratified in the form of alternations of lighter and darker layers. Silt skins are locally present. The entire gravel sequence includes quartz, quartzite, mudstone, mafic volcanic rocks, quartz-feldspar porphyry, felsic intrusive rocks, and various schist clasts. The uppermost gravel is overlain by 5 ft. (1.5 m) of variably frozen damp silt and fine sand forming a moderately cohesive unit containing local dark grey organic laminations.

Drilling penetrated 1-8 ft. (0.3-5.5 m) of mainly sand and silt but was unable to penetrate the frozen cobble gravel sequence.

8.2 River Terrace Placers

8.2.1 Site H - Eureka Creek (4 holes)

Site Description: This site is located along a gently north sloping bench about 20 m (66 ft.) above Indian River, approximately 1 km southwest of the mouth of Eureka Creek. The area has been "brushed" ten years ago and has revegetated to a dry grassy mat and abundant willows over largely unfrozen but locally frozen material. Bulldozer trails have stripped surface vegetation along drill lines. The ground is being tested by AMT Resources.

Site Geology: Bedrock lies approximately 20-30 ft. (6.1-9.1 m) deep and consists of green chlorite schist (Fig. 14-17).

In drill holes H-1 and H-2, bedrock is overlain by 0-15 ft. (0-4.6 m) of brown to very dark greyish brown heterogeneous micaceous gravelly sand and silt with local sandy gravel. This unit appears to pinch out towards the south as it is not intersected in the remaining drillholes (H-3 or H-4). The gravel intersected in the drill hole H-1 appears to grade into a gravelly sand/silt in drill hole H-2. Drill refusal occurred at a depth of 12.5 ft. (3.8 m) at drill hole H-1 and confirmation from previous drill results indicates a coarsening of gravel with depth. The variably frozen, cohesive gravelly material is generally poorly sorted and exhibits a range of moisture content from moist to wet. The consistence of this material ranges from friable to slightly sticky. Silt skins coat several clasts. Clasts are angular to subrounded. Gravel lithology includes micaceous quartzofeldspathic schist, quartz, conglomerate, mudstone, chlorite schist, gneiss, micaceous quartzite, and quartz porphyry clasts. The gravelly sequence is in turn overlain by 7-15 ft. (2.1-4.6 m) of unfrozen dark brown to very dark grey micaceous fine

DRILL HOLE: H-1   MAP: 115O/10   NTS: 607250 E

LOCATION: EUREKA CREEK   HOLE DIAMETER: 4"   ELEV: 1690'   7057050 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-5'	Slightly Gravelly Sandy Silt	Dark Brown - 10YR3/3	< 5	2 cm
5-7'	Slightly Gravelly Sandy Silt	Very Dark Greyish Brown - 10YR3/2	< 1	2 cm
7-9'	Gravelly Silty Sand	Very Dark Greyish Brown - 10YR3/2	20-30	6 cm
9-12.5'	Muddy Sandy Gravel	Very Dark Greyish Brown - 10YR3/2	50	7 cm
12.5'	Refusal			

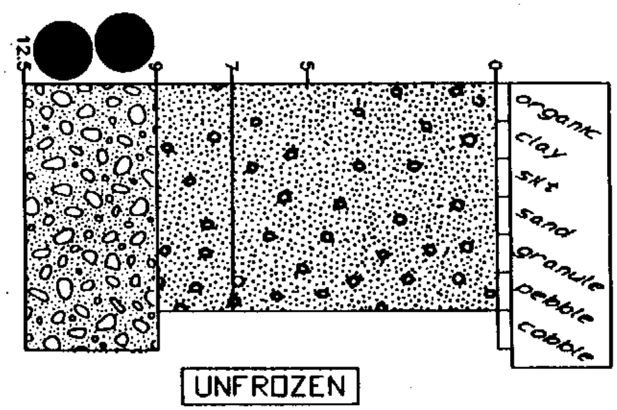


Figure 14: Stratigraphic log of drill hole H-1 (Eureka Creek).

DRILL HOLE: H-2
LOCATION: EUREKA CREEK

MAP: 115O/10
HOLE DIAMETER: 4"

NTS: 607250 E
ELEV: 1691' 7057000 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-2.5'	Fibrous Organics	Very Dark Brown - 10YR2/2		
2.5-7	Muck with Trace Pebbles	Olive Brown - 2.5Y4/3	Trace	1.5 cm
7-10'	Muck with Trace Pebbles	Very Dark Grey - 5Y3/1	Trace	1.5 cm
10-15'	Organic Silty Sand (Muck)	Very Dark Grey - 5Y3/1		
15-20'	Gravelly Sandy Silt	Dark Greyish Brown - 10YR4/2	10	5 cm
20-22.5'	Slightly Gravelly Sand	Brown - 10YR4/3	< 5	5.5 cm
22.5-25'	Gravelly Silty Sand	Very Dark Greyish Brown - 2.5Y3/2	10	4.5 cm
25-30'	Gravelly Sandy Mud	Very Dark Greyish Brown - 2.5Y3/2	10-20	2.5 cm
30-31'	Weathered Bedrock - Schist	Green		

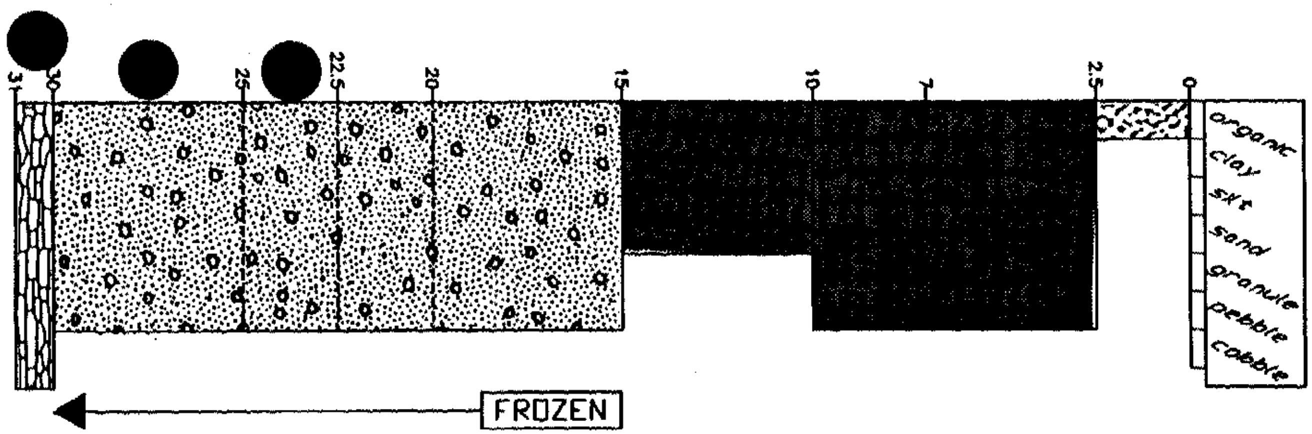


Figure 15: Stratigraphic log of drill hole H-2 (Eureka Creek).

DRILL HOLE: H-3 | MAP: 115O/10 | NTS: 607250 E
LOCATION: EUREKA CREEK | HOLE DIAMETER: 4" | ELEV: 1693' 7056950 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-5'	Muck with Trace Pebbles	Dark Greyish Brown - 2.5Y4/2	Trace	2 cm
5-10'	Muck with Trace Pebbles	Very Dark Grey - 5Y3/1	Trace	5 cm
10-20'	Muck with Trace Pebbles	Very Dark Grey - 5Y3/1	Trace	1.5 cm
> 20'	Bedrock - Schist	Pale Green		

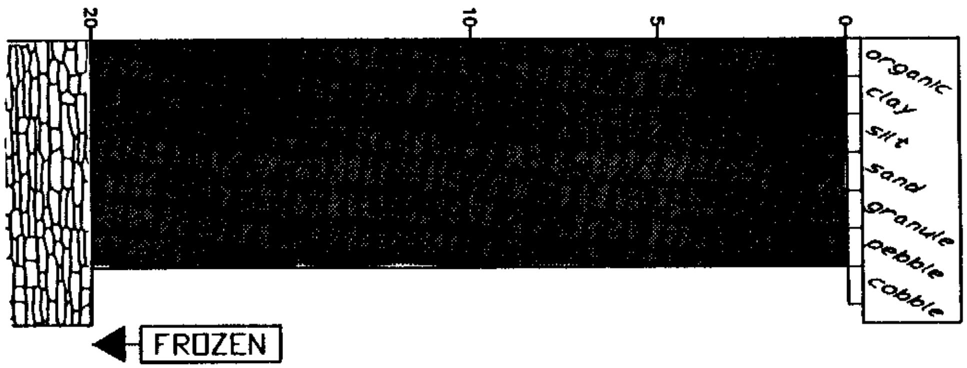


Figure 16: Stratigraphic log of drill hole H-3 (Eureka Creek).

DRILL HOLE: H-4 | MAP: 115O/10 | NTS: 607250 E
LOCATION: EUREKA CREEK | HOLE DIAMETER: 4" | ELEV: 1695' 7056900 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-5'	Muck with Trace Pebbles	Very Dark Grey - 5Y3/1	Trace	2 cm
5-21.8'	Muck with Trace Pebbles	Very Dark Grey - 5Y3/1	Trace	3 cm
21.8-22'	Gravelly Sand	Brown	10-20	2 cm
> 22'	Bedrock - Chlorite Schist	Pale Green		

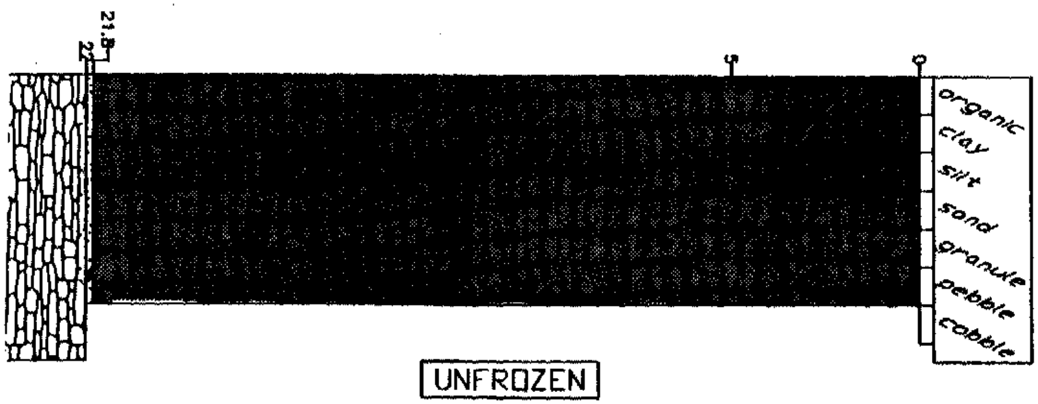


Figure 17: Stratigraphic log of drill hole H-4 (Eureka Creek).

sediments (silt, sand, clay) with variable organic content (muck), and minor pebbles. Moisture content ranges from moist to wet and exhibits a friable to slightly sticky consistence.

Drill holes H-3 and H-4 intersect a different stratigraphic sequence, mainly comprising largely unfrozen dark greyish brown to very dark grey micaceous muck with minor pebbles, overlying bedrock. Moisture content also ranges from moist to wet resulting in a very cohesive material of sticky consistence.

8.2.2 *Site I - Ophir Creek* (2 holes)

Site Description: This site is located on a low terrace on the south side of the Indian River valley and approximately 40 m (130 ft.) above valley bottom. It is situated approximately 2 km southeast of the mouth of Ophir Creek, on a gentle northeast facing slope. The area has been disturbed by stripping done several years ago which has resulted in revegetation comprising grasses, damp moss, and short willows, and a deepening of permafrost. The nearby ground is currently being mined by the Foy family.

Site Geology: Nearby bedrock, medium brown micaceous sandstone, is inferred to be at least 33' (10.1 m) deep (Fig. 18, 19). It outcrops at the bottom of nearby trenches.

Bedrock is generally overlain by a 30 ft. (9.1 m) poorly sorted sequence of brown to black muck consisting mainly of silt, fine sand and lesser clay, with gravelly zones 7-13 ft. (2.1-4.0 m) thick. The muck is frozen below 12 ft. Overall moisture content is wet, although muck near the surface is just moist. High cohesiveness is consistent throughout the sequence. Gravel clasts are subangular to subrounded. Gravel lithology includes micaceous quartzite, quartz, siltstone, micaceous quartzofeldspathic schist, and chert clasts.

8.3 Stream Placers

8.3.1 *Site B - Last Chance Creek* (1 hole)

Site Description: This site is located 60 m east of Last Chance Creek, along the valley floor, between 15 Above Pup and Henrietta Pup. It is a flat, swampy, wet boggy area covered with moss, willows and scattered spruce. The drill site is on a recent bulldozer trail adjacent to the east facing hillside. Drainage is poor and the area is mostly underlain by permafrost. The ground

DRILL HOLE: I-1	MAP: 115O/14	NTS:	582525 E
LOCATION: OPHIR CREEK	HOLE DIAMETER: 4"	ELEV: 1470'	7071225 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-6'	Gravelly Sand (anthropogenic)	Dark Yellowish Brown - 10YR4/6	10-20	4.5 cm
6-12.5'	Organic Silt (Muck)	Black (2.5Y2/0) and Dark Olive Grey		
12.5-15'	Gravelly Sandy Silt (Organic)	Dark Olive Grey - 5Y3/2	10-20	3.5 cm
15-19.5'	Gravelly Organic Silt	Very Dark Grey - 5Y3/1	20	2 cm
19.5-25'	Slightly Gravelly Sandy Silt (Organic)	Very Dark Grey - 5Y3/1	1	1.5 cm
25-35'	Organic Silt (Muck)	Very Dark Grey - 5Y3/1		
35-35.5'	Bedrock - Sandstone	White Powder		

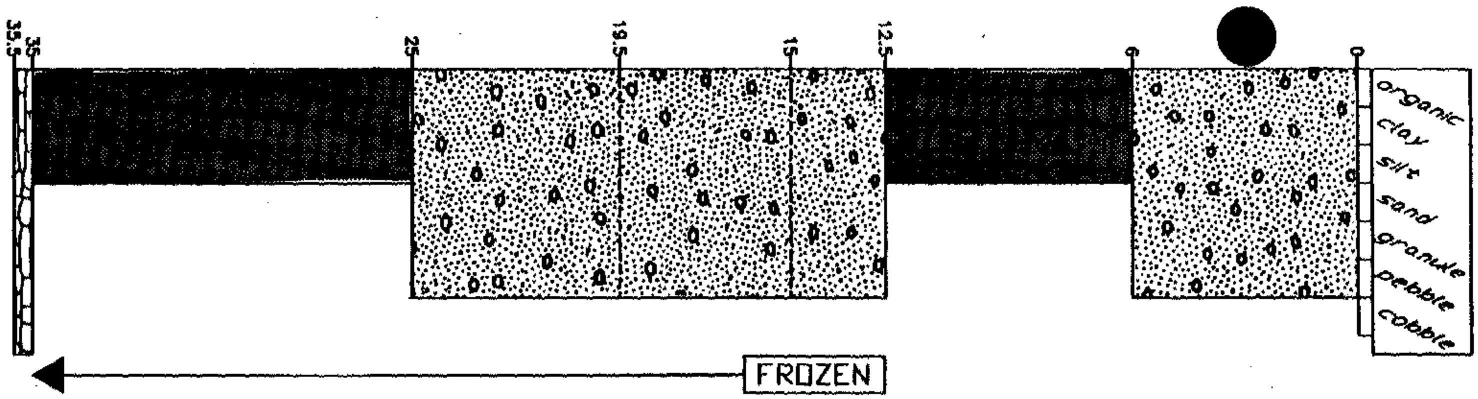


Figure 18: Stratigraphic log of drill hole I-1 (Ophir Creek).

DRILL HOLE: I-2 MAP: 1150/14 NTS: 582600 E
LOCATION: OPHIR CREEK HOLE DIAMETER: 4" ELEV: 1460' 7071200 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-5'	Organic Silt (Muck)	Dark Greyish Brown - 10YR4/2		
5-20'	Organic Silt (Muck)	Very Dark Grey - 10YR3/1		
20-25'	Gravelly Sandy Silt (Organic)	Brown - 10YR5/3	5	1.5 cm
25-33'	Gravelly Silt (Organic)	Very Dark Grey - 10YR3/1	20	2 cm
> 33'	Bedrock - Sandstone	White Powder		

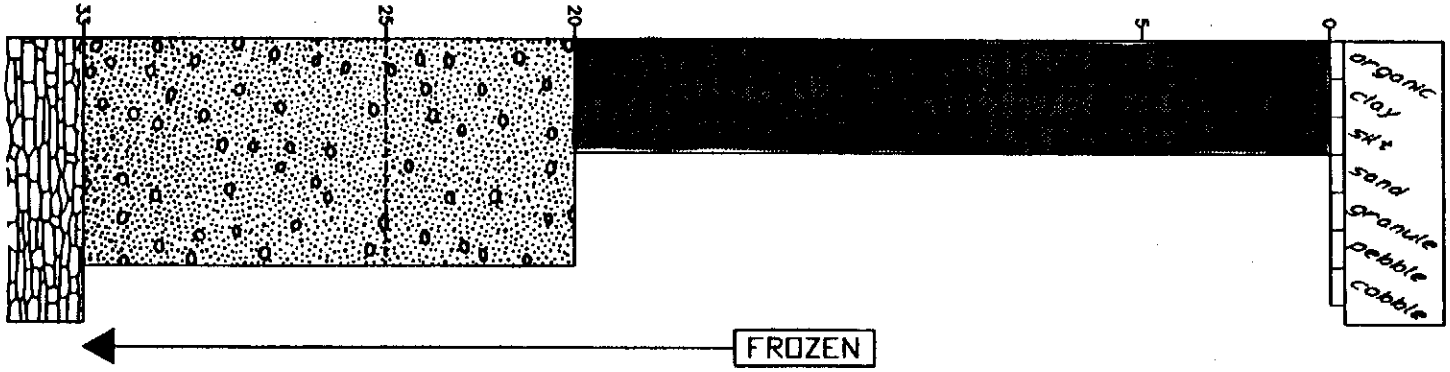


Figure 19: Stratigraphic log of drill hole I-2 (Ophir Creek).

is owned and has been previously drilled by Lokey Mining Services Ltd.

Site Geology: Bedrock was not reached by our drill hole but is locally mapped as buff weathering muscovite-feldspar-quartz schist (Debicki, 1984).

Surficial material consists of generally frozen colluvial muck which comprises angular graphitic schist, muscovite schist, and quartzite rock fragments (Fig. 20). The matrix is a typical dark to very dark grey, commonly laminated muck consisting of micaceous silt, fine sand, and lesser clay. Moisture content is generally wet, and the material displays a sticky consistency. The angularity and lithology of clasts and the absence of fluvial material imply a colluvial origin for the material.

8.3.2 *Site C - Washington Creek* (3 holes)

Site Description: This site is located 0.5 km southeast of the mouth of Washington Creek, on the east side of Dominion Creek. It is part of a wide swampy area which makes up the lower Dominion Creek valley. The area is vegetated with grass, moss, willows and sparse spruce. The ground is owned and has been previously drilled by Ross Mining.

Site Geology: Bedrock was not reached at this site but is estimated to be about 30' (9 m) deep, according to previous drilling. Local bedrock consists of buff weathering muscovite-feldspar-quartz schist (Debicki, 1984).

Drilling intersected a 7.5-11 ft. (2.3-3.4 m) sequence of partially frozen poorly sorted, mostly olive brown and lime green gravelly muddy sand (Fig. 21-23). Based on previous drilling, depth of drilling refusal coincides with a transition to a coarse gravel. Pebble size gravel is angular to subrounded and gravel lithology consists of quartz, micaceous quartzite, and chlorite schist clasts. Moisture content is moist to wet and consistence varies from loose to slightly sticky. The gravelly material is overlain by a variably (dark) coloured sequence, 12-13.5 ft. (3.7-4.1 m) thick, of mostly frozen interlayered muck and fibrous organics. The muck consists of micaceous silt, fine sand and minor clay and exhibits a range of colours from dark brown to dark grey, depending on organic content. The fibrous organics consist of distinctly dark reddish brown peat. Thin layers of lighter coloured olive brown sand are also locally present. The muck sequence is wet and consistence ranges from nonsticky in the sandy zones to slightly sticky in the silty zones.

DRILL HOLE: B-1 | MAP: 115O/14 | NTS: 591285 E
LOCATION: LAST CHANCE CREEK | HOLE DIAMETER: 4" and 3" | ELEV: 1620' 7095388 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-5'	Colluvial Muck	Dark Grey - 10YR4/1	10	3 cm
5-12'	Colluvial Muck	Very Dark Grey - 2.5Y3/2	20	4 cm
12-15'	Colluvial Muck	Very Dark Grey - 2.5Y3/2	20	6 cm
15-21'	Colluvial Muck	Dark Olive Grey - 5Y3/2	20-30	10 cm
21-24'	Colluvial Muck	Dark Olive Grey - 5Y3/2	< 5	3 cm
24-27'	Colluvial Muck	Very Dark Grey - 5Y3/1	10-15	4.5 cm
27-30'	Colluvial Muck	Very Dark Grey - 5Y3/1	20-30	5 cm
30-36'	Colluvial Muck	Dark Grey - 5Y4/1	5-10	3 cm

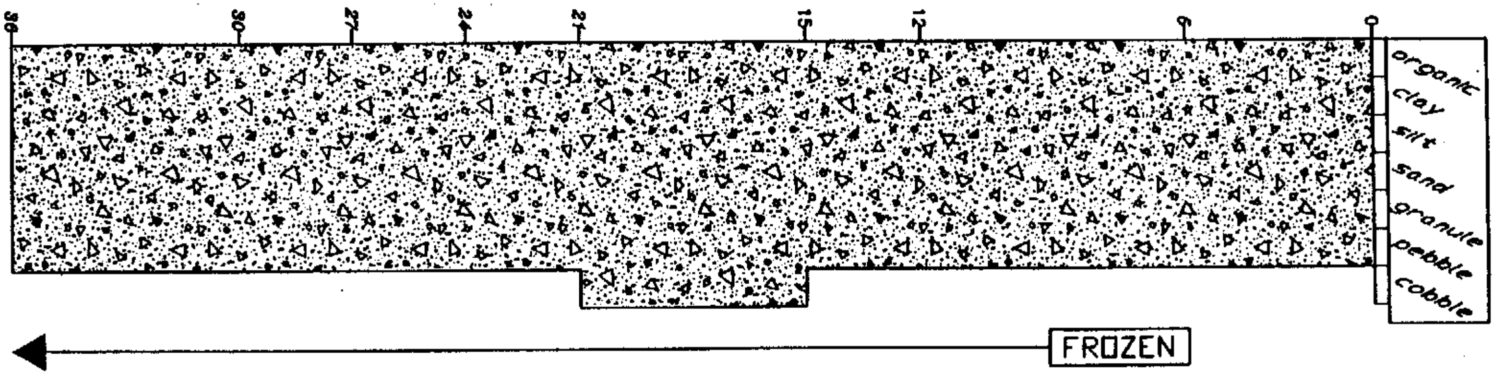


Figure 20: Stratigraphic log of drill hole I-2 (Last Chance Creek).

DRILL HOLE: C-1 | MAP: 115O/10 | NTS: 621250 E

LOCATION: WASHINGTON CREEK | HOLE DIAMETER: 3" | ELEV: 1840' | 7068000 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-6'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
6-7'	Organic Sandy Silt (Muck)	Dark Brown - 10YR3/3		
7-7.5'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
7.5-10'	Organic Sandy Silt (Muck)	Dark Olive Brown - 2.5Y3/3		
10-10.5'	Fibrous Organics	Olive Brown - 2.5Y4/3		
10.5-11.5'	Organic Sandy Silt (Muck)	Dark Olive Brown - 2.5Y3/3		
11.5-12'	Fine Sand	Olive Brown - 2.5Y4/3		
12-12.5'	Organic Sandy Silt (Muck)	Dark Olive Grey - 5Y3/2		
12.5-13'	Sand	Light Olive Brown - 2.5YR5/4		
13-13.5'	Organic Sandy Silt (Muck)	Olive Brown - 2.5Y4/3		
13.5-15'	Gravelly Silty Sand	Dark Yellowish Brown - 10YR4/6	5-10	3 cm
15-18'	Gravelly Sand	Olive Brown - 2.5Y4/3	10	1 cm
18-21'	Gravelly Sandy Organic Silt	Olive Brown - 2.5Y4/3	5-10	1 cm
21'	Refusal			

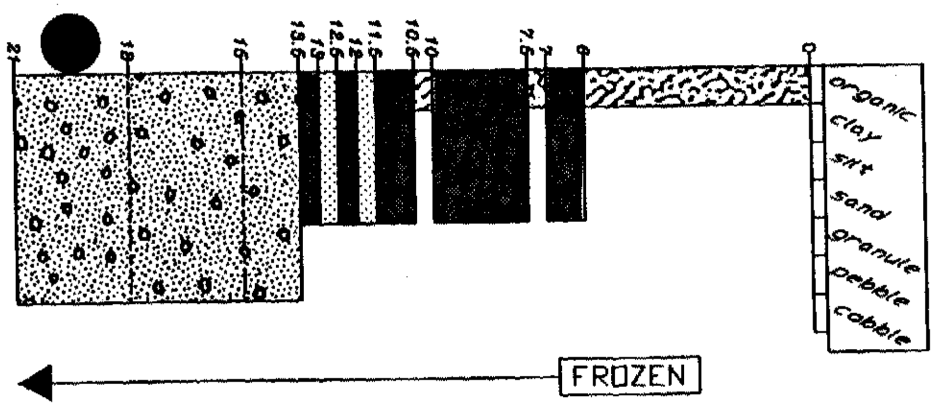


Figure 21: Stratigraphic log of drill hole C-1 (Washington Creek).

DRILL HOLE: C-2 MAP: 115O/10 NTS: 621300 E
LOCATION: WASHINGTON CREEK HOLE DIAMETER: 3" ELEV: 1840' 7068000 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Organic Sandy Silt (Muck)	Dark Olive Grey - 5Y3/2		
3-4.5'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
4.5-5.5'	Organic Sandy Silt (Muck)	Olive Grey - 5Y4/2		
5.5-7'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
7-8'	Fibrous Organics and Muck	Olive Grey and Dark Reddish Brown		
8-9.5'	Sand with Organic Laminations	Olive Grey - 5Y4/2		
9.5-12'	Sand and Silt (Interlayered)	Olive Grey - 5Y4/2		
12-15'	Gravelly Muddy Sand	Lime Green	5	1 cm
15-23'	Gravelly Muddy Sand	Lime Green	20	2 cm
23'	Refusal			

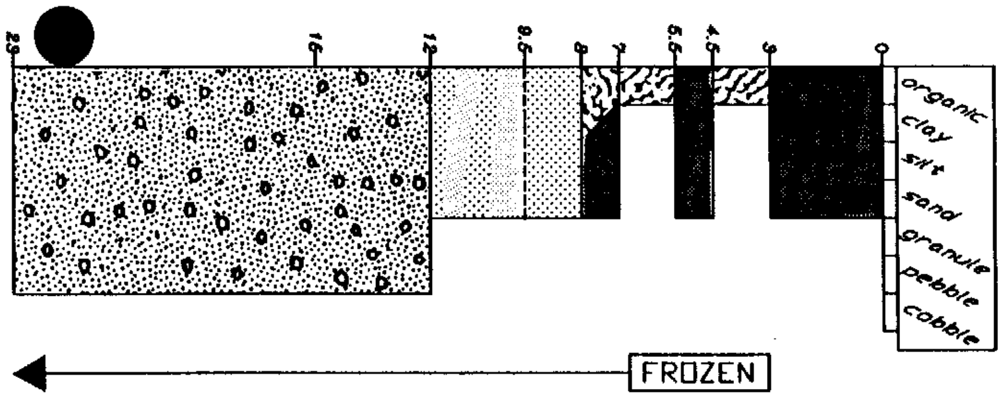


Figure 22: Stratigraphic log of drill hole C-2 (Washington Creek).

DRILL HOLE: C-3	MAP: 115O/10	NTS:	621350 E
LOCATION: WASHINGTON CREEK	HOLE DIAMETER: 3"	ELEV: 1840'	7068000 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
3-5'	Organic Sandy Silt (Muck)	Olive Brown - 2.5Y4/3		
5-5.5'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
5.5-6'	Organic Sandy Silt (Muck)	Olive Brown - 2.5Y4/3		
6-7'	Fibrous Organics	Dark Reddish Brown - 5YR3/3		
7-12'	Silty Sand	Olive Brown - 2.5Y4/3		
12-15'	Gravelly Silty Sand	Light Olive Brown - 2.5Y5/4	10	1 cm
15-18'	Gravelly Silty Sand	Light Olive Brown - 2.5Y5/4	20	1.5 cm
18-20.5'	Gravelly Silty Sand	Light Olive Brown - 2.5Y5/4	30	2 cm
20.5'	Refusal			

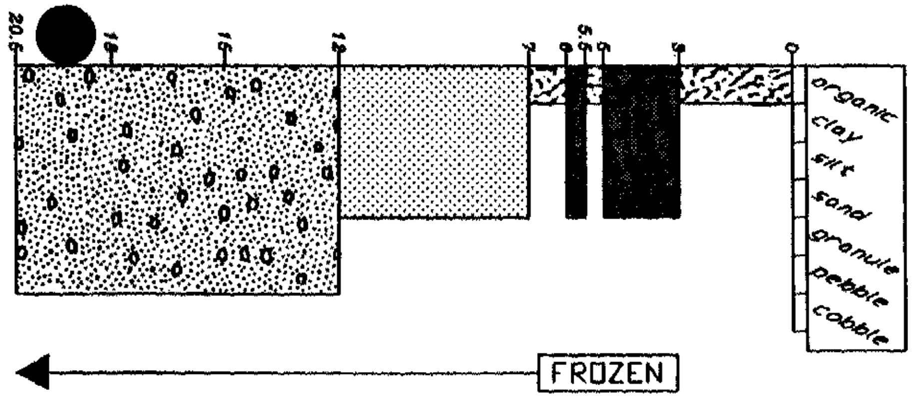


Figure 23: Stratigraphic log of drill hole C-3 (Washington Creek).

8.3.3 *Site D - Gold Run Creek* (4 holes)

Site Description: This site is located approximately 1 km upstream from the mouth of Gold Run Creek, within 75 m of the creek bed. The area was stripped about 50 years ago and is covered with old tailings. It is now revegetated with grass, moss, and willows. The ground is generally dry to damp and unfrozen. The site was sampled by churn drilling in the 1940's by the Yukon Consolidated Gold Corporation (YCGC). Teck Mining Corporation is currently mining this deposit about half a kilometer downstream from this site.

Site Geology: Bedrock is 24-30 ft. (7.3-9.1 m) deep and consists of chlorite schist which is strongly weathered/altered to a lime green, wet, sticky clay gouge with small bedrock chips (Fig. 24-27). This weathered horizon can be as much as 10 ft. (3 m) thick.

The weathered bedrock is overlain by a 6-20 ft. (1.8-6.1 m) thick gravelly sequence of mainly yellowish brown to olive brown, unfrozen, micaceous gravelly sand to sandy gravel which includes silt and sand horizons. Moisture content ranges from moist, near the surface, to wet, near the water table. Material consistency spans from very friable (moist) to non sticky (wet). Pebble size clasts are angular to subangular and mainly consist of quartz, chlorite schist, and muscovite schist. This gravelly sequence is overlain by 6-12 ft. (1.8-3.7 m) of unfrozen, mostly brown, well sorted micaceous sand and silt with minor pebble size clasts. Moisture content ranges from moist to wet and overall material consistence is loose (moist) to nonsticky (wet). The entire stratigraphy is topped with an layer of old gravel tailings.

Hole D-4 was drilled over 300 m away from the other three holes (D-1, D-2, D-3) and comprises a slightly different stratigraphy. Bedrock, the same chlorite schist, is overlain by a mostly frozen 6 ft. (1.8 m) sequence of non-organic olive green gravelly mud. This unit appears to represent weathered bedrock (clay gouge) mixed with small, angular quartz and chlorite schist pebbles. It is overlain by 18 ft. of mostly frozen, slightly sticky very dark grey muck consisting of silt and fine sand.

8.3.4 *Site E - Sulphur Creek* (1 hole)

Site Description: This site is located about 2 km upstream from the mouth of Sulphur Creek and on the southwest side of the creek valley, adjacent to old placer tailings. The area is undisturbed and part of an old marsh which is

DRILL HOLE: D-1 MAP: 115O/10 NTS: 617875 E

LOCATION: GOLD RUN CREEK HOLE DIAMETER: 3" and 4" ELEV: 1855' 7066000 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Gravelly Silty Sand (anthropogenic)	Dark Yellowish Brown - 10YR4/6	25	2 cm
3-6'	Slightly Gravelly Sand	Yellowish Brown - 10YR5/6	< 5	2.5 cm
6-15'	Sand	Brown - 10YR4/3		
15-18'	Slightly Gravelly Sand	Dark Brown - 10YR3/3	1	1 cm
18-21'	Slightly Gravelly Muddy Sand	Olive - 5Y5/3	< 1	1 cm
21-29.25'	Weathered Bedrock - Chlorite Schist	Pale Lime Green		

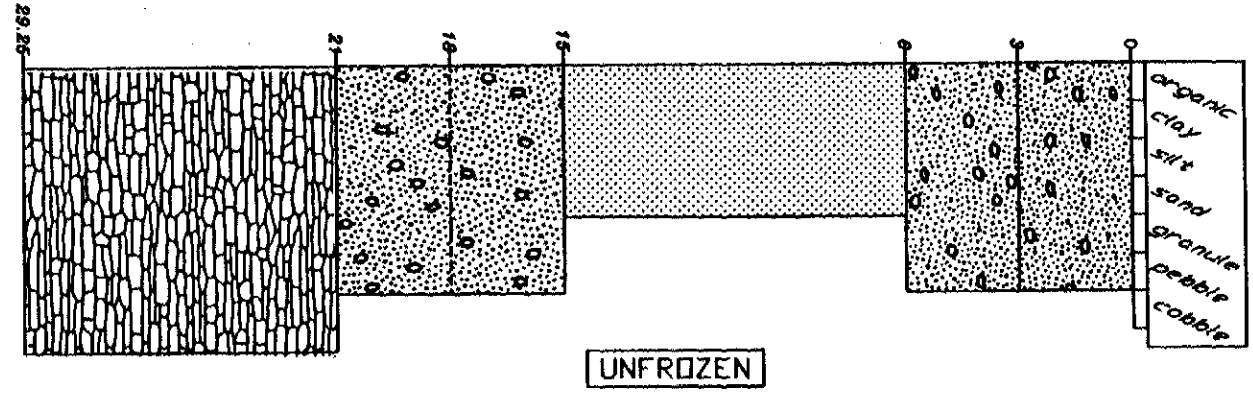


Figure 24: Stratigraphic log of drill hole D-1 (Gold Run Creek).

DRILL HOLE: D-2 | MAP: 1150/10 | NTS: 617850 E
LOCATION: GOLD RUN CREEK | HOLE DIAMETER: 3" and 4" | ELEV: 1850' 7065975 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Gravelly Sand (anthropogenic)	Dark Yellowish Brown - 10YR4/6	10-20	2 cm
3-6'	Silty Fine Sand	Brown - 10YR4/3		
6-9'	Silty Sand	Brown - 10YR4/3		
9-12'	Gravelly Silty Sand	Olive Brown - 2.5Y4/3	10-20	0.4 cm
12-18'	Gravelly Coarse Sand	Light Olive Brown - 2.5Y5/3	5	2 cm
18-21'	Sandy Silt	Very Dark Greyish Brown - 2.5Y3/2		
21-27'	Gravelly Coarse Sand	Dark Greyish Brown - 2.5Y4/2	5	2.5 cm

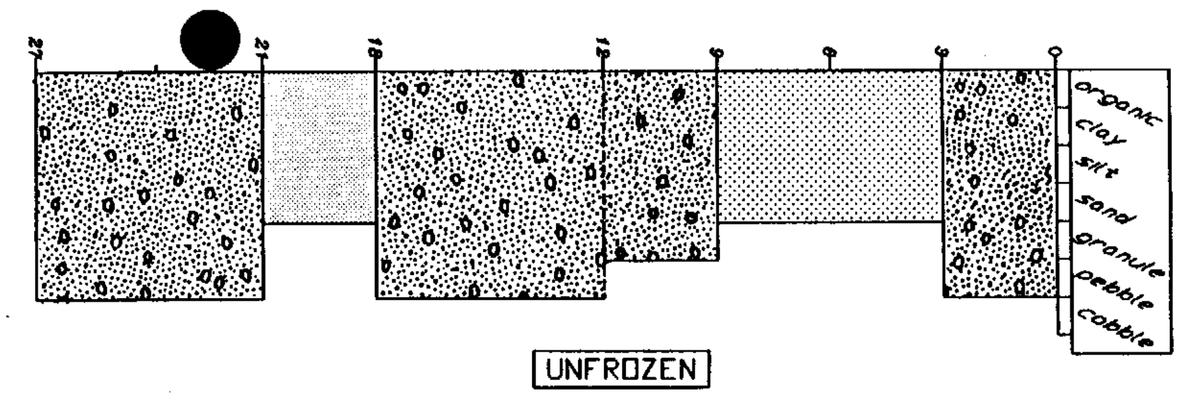


Figure 25: Stratigraphic log of drill hole D-2 (Gold Run Creek).

DRILL HOLE: D-3 MAP: 115O/10 NTS: 617830 E
LOCATION: GOLD RUN CREEK HOLE DIAMETER: 3" ELEV: 1840' 7065950 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Gravelly Muddy Sand (anthropogenic)	Very Dark Greyish Brown - 10YR3/2	10	8 cm
3-6'	Slightly Gravelly Silty Sand	Dark Greyish Brown - 2.5Y4/2	1	3 cm
6-9'	Slightly Gravelly Silty Sand	Very Dark Grey - 10YR3/1	1	2.5 cm
9-15'	Gravelly Sand and Silt (interlayered)	Yellowish Brown and Dark Brown	10	2.5 cm
15-18'	Gravelly Silty Sand	Olive Brown - 2.5Y4/4	5-10	1 cm
18-24'	Gravelly Sand	Olive Brown - 2.5Y4/3	5-10	2 cm
24-28.5'	Muddy Sandy Gravel	Olive Brown - 2.5Y4/3	35	2 cm
> 28.5'	Bedrock - Chlorite Schist	Green		

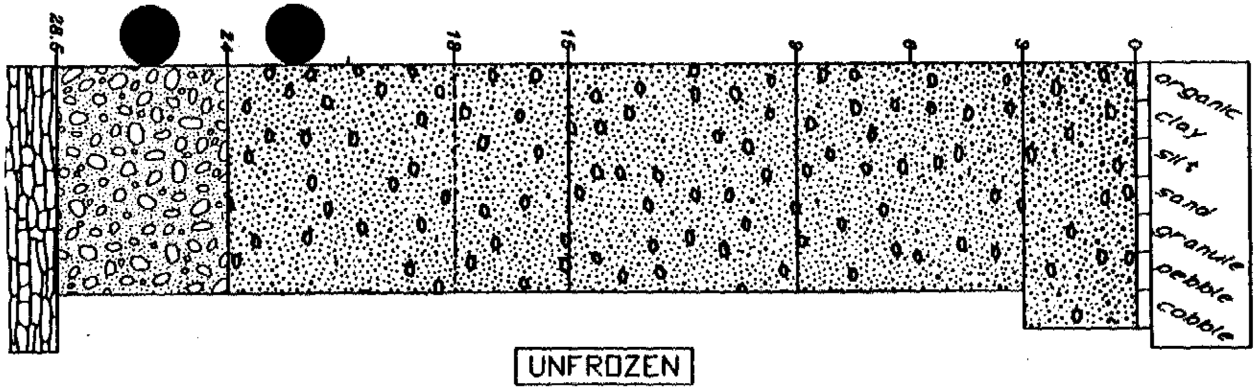


Figure 26: Stratigraphic log of drill hole D-3 (Gold Run Creek).

DRILL HOLE: D-4 | MAP: 115O/10 | NTS: 618050 E
LOCATION: GOLD RUN CREEK | HOLE DIAMETER: 4" and 3" | ELEV: 1830' 7065700 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-6'	Organic Silt (Muck)	Very Dark Grey - 10YR3/1		
6-12'	Organic Silt (Muck)	Dark Grey - 10YR4/1		
12-15'	Organic Sandy Silt (Muck)	Very Dark Grey - 10YR3/1		
15-18'	Slightly Gravelly Mud	Khaki Green	< 1	1 cm
18-21'	Gravelly Mud	Yellowish Khaki Green	5-10	0.4 cm
21-30'	Weathered Bedrock - Gouge	Khaki Green		

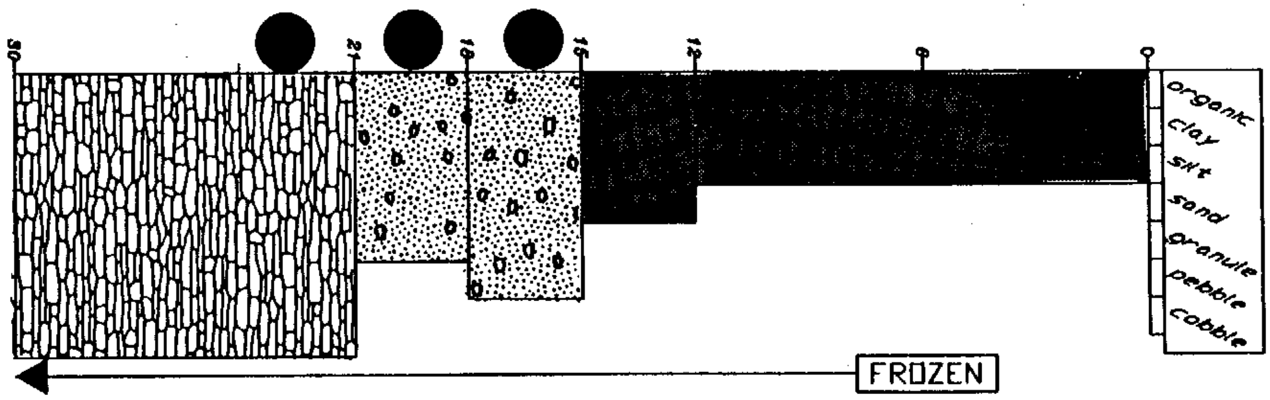


Figure 27: Stratigraphic log of drill hole D-4 (Gold Run Creek).

now dry on the surface and vegetated with a cover of grass, moss, willows and clusters of spruce. The ground is owned by Airgold Ltd.

Site Geology: Drilling did not intersect bedrock which exceeds a depth of 29 ft. (8.8 m) and is locally mapped as chlorite schist (Mortenson, 1990).

An olive to dark greyish brown, frozen, poorly sorted gravelly silty sand containing organic-rich horizons is at least 13 ft. (4 m) thick and forms the deepest stratigraphy drilled (Fig. 28). Angular to subangular fine pebble-size gravel includes predominantly quartz, and lesser muscovite schist, chlorite schist, and granitic rock. Upon thawing, moisture content is wet and material consistence is slightly sticky. This gravelly sequence is overlain by 16 ft. (4.9 m) of dark to very dark brown frozen, sticky muck consisting mainly of silt and clay.

8.3.5 Site F - Dominion Creek (2 holes, 1 logged)

Site Description: This site is located approximately 50 m west of Dominion Creek, about 2 km upstream from its mouth. The area lies within dredge tailings and an old settling pond from old YCGC (Yukon Consolidated Gold Corporation) workings. Therefore much of the surficial material is anthropogenic. The site is unvegetated, dry, and unfrozen. The ground is owned by Airgold, which runs a placer operation farther downstream.

Site Geology: Bedrock comprises a pinkish coarse meta-granodiorite. It was not intersected by drilling but is visible nearby in large angular blocks.

At least 10 ft. (3.0 m) of disturbed loose dry gravel (anthropogenic) from old tailings cover the stratigraphic sequence at this site (Fig. 29). A nearby pit indicates that this gravel is underlain by a sequence of sand and silt believed to be part of an old settling pond (John Brown, pers. comm., 1994). Drilling indicates an 11 ft. (3.4 m) thick sequence of moist gravelly muddy sand which may be erroneous and caused by the loosening of the unfrozen gravel from above. The fineness and dark grey-brown colour of the matrix material implies that this is the same material as that observed in the pit. Based on a nearby mining cut, refusal depth coincides with a transition to coarser gravel including large cobbles or boulders. Gravel lithology includes quartz, muscovite-quartz-feldspar schist, and chlorite-quartz schist clasts.

DRILL HOLE: E-1
LOCATION: SULPHUR CREEK

MAP: 115O/10
HOLE DIAMETER: 4"

NTS: 614845 E
ELEV: 1740' 7061125 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Fibrous Organics and Muck	Dark Olive Brown - 2.5Y3/3		
3-16'	Organic Mud (Muck)	Very Dark Greyish Brown - 2.5Y3/2		
16-20'	Gravelly Silty Sand	Olive - 5Y5/3	20	2 cm
20-26'	Gravelly Silty Sand	Dark Greyish Brown - 2.5Y4/2	20	3 cm
26-29'	Gravelly Muddy Sand	Olive Grey - 5Y5/2	20-30	2 cm

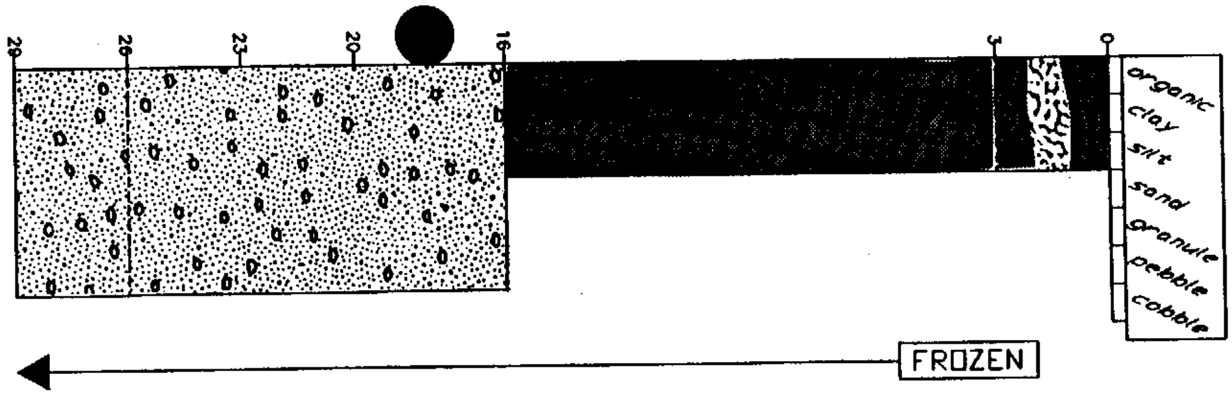


Figure 28: Stratigraphic log of drill hole E-1 (Sulphur Creek).

DRILL HOLE: F-1 | MAP: 115O/10 | NTS: 614550 E

LOCATION: DOMINION CREEK | HOLE DIAMETER: 4" | ELEV: 1720' 7057850 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-5'	Sandy Gravel (anthropogenic)	Brown	40-50	15 cm
5-10'	Sandy Gravel (anthropogenic)	Brown	40-50	7 cm
10-15'	Gravelly Muddy Sand	Light Olive Brown - 2.5Y5/4	20	5 cm
15-19'	Gravelly Muddy Fine Sand	Very Dark Greyish Brown - 2.5Y3/2	10	2 cm
19-21'	Gravelly Muddy Sand	Dark Greyish Brown - 2.5Y4/2	10-20	3 cm
21'	Refusal			

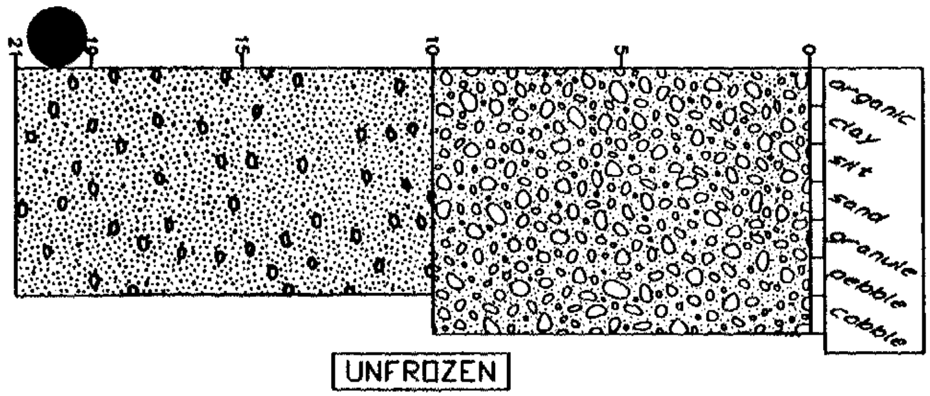


Figure 29: Stratigraphic log of drill hole F-1 (Dominion Creek).

8.3.6 *Site G - Indian River* (2 holes)

Site Description: This site is located next to the Indian River, approximately 3 km upstream from the mouth of Eureka Creek. The drill area lies within mostly mossy forested floodplain material within the modern Indian River valley. Bulldozer trails have been put in by pushing mature spruce trees with heavy equipment to allow access for recent auger drilling. Most of the ground is frozen. Aurion Placers is currently mining dowstream from this site.

Site Geology: Site G is the only river placer deposit drilled. Bedrock is relatively shallow at a depth of 10-15 ft. (3.0-4.6 m) and is made up of chlorite schist (Fig. 30, 31).

It is overlain by 4-6 ft. (1.2-1.8 m) of frozen, olive to olive brown poorly sorted gravelly muddy sand to muddy sandy gravel. Moisture content is wet and material consistence is slightly sticky. Pebble size clasts are angular to subrounded. Gravel lithology includes quartz, quartz-feldspar-mica schist, chlorite schist, and mudstone clasts. The gravelly sequence is mostly overlain by up to 6.5 ft. (2.0 m) of partially frozen, very dark greyish brown micaceous muck consisting of silt and fine sand and includes horizons of fibrous organic matter. Only the top 3 ft. of the muck sequence is unfrozen. Moisture content is generally wet and material consistence is slightly sticky.

DRILL HOLE: G-1 | MAP: 115O/10 | NTS: 610000 E
LOCATION: INDIAN RIVER | HOLE DIAMETER: 4" | ELEV: 1650' 7056500 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-3'	Fibrous Organics and Muck	Dark Brown - 7.5YR3/2		
3-6'	Organic Sandy Silt (Muck)	Very Dark Greyish Brown - 2.5Y3/2		
6-10'	Gravelly Muddy Sand	Olive Brown - 2.5Y4/4	10	2.5 cm
> 10'	Bedrock - Schist	Green		

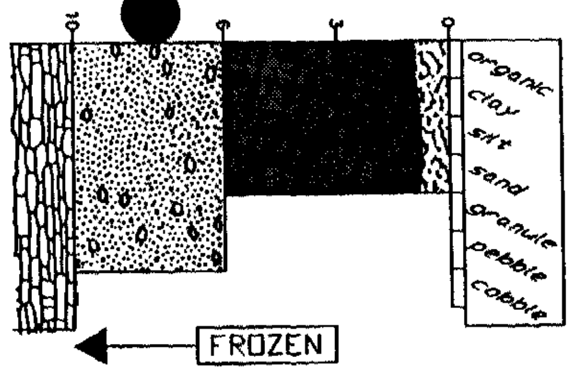


Figure 30: Stratigraphic log of drill hole G-1 (Indian River).

DRILL HOLE: G-2 | MAP: 115O/10 | NTS: 610075 E
LOCATION: INDIAN RIVER | HOLE DIAMETER: 4" | ELEV: 1650' 7056400 N

INTERVAL	LITHOLOGY	COLOUR - MUNSELL CODE	% GRAVEL	MAX. SZ.
0-6.5'	Organic Sandy Silt (Muck)	Very Dark Greyish Brown - 2.5Y3/2		
6.5-11.5'	Muddy Sandy Gravel	Olive Brown - 2.5Y4/4	40	2 cm
11.5-13'	Muddy Sandy Gravel and Bedrock	Olive - 5Y5/3	40	2 cm
> 13'	Bedrock - Schist	Green		

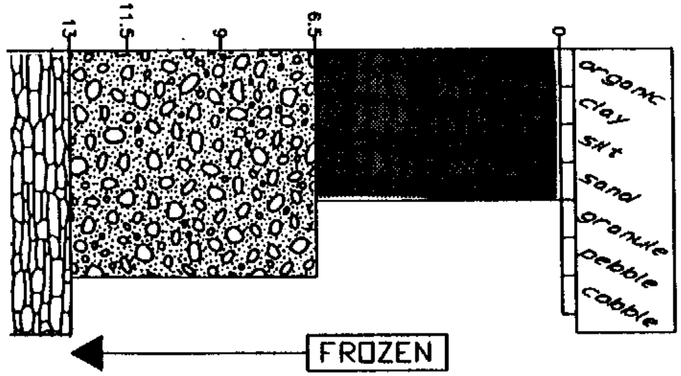


Figure 31: Stratigraphic log of drill hole G-2 (Indian River).

9 CONCLUSION

Despite numerous mechanical breakdowns, the ATV drill rig used for this project was capable of partially achieving most of the objectives set out for this project, at a reasonable performance level. However, this drill rig would require major modifications to increase its drilling efficiency, after which it still probably would not perform as well as new drills of similar design which have used current technology.

The first objective of this project comprised testing the ATV drill under Yukon conditions in a placer mining district. Drilling on active, road-accessible properties, as undertaken on this project, does not provide a full spectrum of conditions and possible problems encountered by drilling in new, relatively unexplored, potentially more rugged placer mining areas. Testing of the ATV drill rig revealed certain limiting factors which include:
1) low ground clearance (14 cm) limits use of the ATV drill to areas where microtopography is relatively smooth or where roads and/or bulldozer trails are present
2) poor ground manoeuvrability and a wide turning radius
3) an unnecessarily long mast (4.3 m), which results in awkward transportation and instability when in operation.

The second objective consisted of evaluating the ATV drill for future helicopter supported grassroots exploration. The weight of the ATV drill (908 kg or 2000 lbs), although light compared to auger drills commonly used in the Klondike, still requires two loads in a medium size helicopter (e.g. Bell 206 Long Ranger). Slinging with such a helicopter is of course more expensive than with a small helicopter (e.g. Bell 206 Jet Ranger), reducing its desirability as a cost effective option. Ground transport with a truck-towed trailer proved to work well in road accessible areas.

The third objective was to evaluate drilling performance, through a variety of surficial materials encountered in alluvial placer deposits, under different permafrost conditions. The auger drill itself, a modified Winkie drill, performed moderately well for a drill of its size and capacity. It was capable of drilling through most frozen and unfrozen surficial materials encountered including: muck, silt, sand, gravelly sand, sandy pebble and cobble gravel, and weathered bedrock. The drill was incapable of drilling through gravel with a significant proportion of clasts exceeding about 10 cm (cobble size). It drilled 3.5 in. and 4.5 in. (8.9 cm and 11.4 cm) holes to a maximum depth of 36 ft. (11 m), although it has been known to drill holes exceeding 12 m (40 ft.) in finer materials.

Drilling penetration rates were mainly controlled by an interplay of four factors: 1) degree of freezing; 2) clast size; 3) distribution of clast size; and 4) degree of cohesiveness of the material. Unfrozen ground was easier and faster to drill than frozen ground. Coarse materials and/or a higher concentration of coarse clasts were more difficult to penetrate than finer materials or ones with a low percentage of coarser clasts. Highly cohesive horizons caused clogging and resulted in slow drilling compared to less cohesive or loose horizons. The fastest drilling took place in unfrozen fine grained loose uncohesive ground, whereas the slowest drilling occurred in frozen coarse grained cohesive ground.

The fourth objective comprised of studying the stratigraphy at various placer deposits in the Klondike district, including depth to bedrock, gravel and muck characteristics, and permafrost conditions. The ATV drill provided adequate samples for stratigraphic study. Depth to bedrock (where reached), permafrost, thickness of gravelly material, and thickness of muck were easily assessed with the ATV drill. However, the disturbed nature of samples obtained in auger drilling with conventional drill bits does not lend itself to accurate, detailed, stratigraphic descriptions. Auger drilling, particularly with smaller diameter augers, also preferentially retrieves the finer and more cohesive size fraction of the original material. This leads to a misleading interpretation regarding its composition as being finer grained than it actually is. Core sampling tools, which produce undisturbed samples, are far more effective in providing more thorough information on overburden stratigraphy. Undoubtedly, stratigraphic descriptions from exposed cuts, trenches, or pits are most representative and allow for greater interpretation. However, remote exploration sites may not have the surface exposures to compare with drilling.

The fifth objective was to test 3.5 in. (8.9 cm) and 4.5 in. (11.4 cm) diameter auger drilling for the presence of placer gold. Our results show that the ATV drill is able to assess gold presence and provide approximate gold values, using 3.5 in. (8.9 cm) and 4.5 in. (11.4 cm) diameter holes. It retrieved gold from 13 out of 23 holes in quantities sufficient to calculate values for specific depth intervals. However, the ability of the drill to detect the presence of gold is limited to its penetration capability. Therefore, since the drill was unable to penetrate coarse gravel, any gold occurring in such gravel would unfortunately not be accounted for and would potentially be misleading. Nevertheless, the presence of gold in finer gravel is usually a good indicator of finding gold in coarser gravel and the results would probably err on the conservative side.

Finally, the last objective consisted of comparing gold results with those obtained from reserve delineation drilling using larger drill rigs, wherever possible. Twinning of eleven holes with previous (larger diameter) drilling allowed for the comparison of gold values. Due to a number of factors, results were too erratic to be conclusive. However, the ATV drill retrieved gold in five out of six twinned holes where previous drilling established the occurrence of gold. In addition, gold was frequently found in gravelly material stratigraphically higher (up to 5 m above) than the bedrock-gravel interface zone, which is often selectively sampled by larger diameter drilling. Therefore, the ATV drill detected the presence of placer gold where larger diameter auger drills detected gold. However, because of the smaller hole size, the ATV drill could not duplicate the accuracy of larger diameter drilling.

10 RECOMMENDATIONS

The technology for the ATV drill rig is obsolete and as a result the effectiveness for prospecting for new placer deposits using this rig is reduced. The ideal drill rig for undertaking this type of work should have a combination of the following characteristics:

- Lightweight (for easier and more economical transportability)
- Relatively small and compact
- A higher horsepower to weight and size than the ATV drill rig
- Air transportable (preferably by small helicopter, e.g. Bell 206 Jet Ranger)
- Easily assembled and disassembled for convenient portability
- Mobile and self-propelling
- Capable of accessing remote sites and rugged terrain (e.g. vertical stability, higher ground clearance than ATV drill, good traction, low center of gravity, large tires)
- Minimal environmental impact (low ground pressure; preferably equipped with balloon tires).

The selection of the most appropriate drill rig for future similar studies should be thoroughly researched before a decision is made. The placer mining industry and the drilling services and supply sectors should be consulted to find out what lightweight drill rigs are available on the market and which ones work best in a typical Yukon placer deposit setting. A full spectrum of good quality drill equipment, particularly drill bits, and tools appropriate to placer geology applications are important to the success of a drill project. As a breaking-in exercise, the selected drill rig should be tested locally before attempting to drill in remote areas.

Future drilling programs of similar nature should concentrate on systematically drilling more holes across entire valley floors or terraces. This would allow for stratigraphic correlation and valley profiles or cross-sections and for establishing gold values laterally as well as vertically. Core sampling should be considered for the purpose of obtaining undisturbed samples for stratigraphic study and uncontaminated or minimally contaminated samples for placer gold testing. Wherever possible, drilling should be undertaken near an exposed face to permit stratigraphic correlation between drilled material versus in-situ material.

11 ACKNOWLEDGEMENTS

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Aurion Placers (Nona "Bows" and John Lovelace)
Dennis and Liz Foy and family
Lokey Mining Services Ltd. (Lee Olynyk and Ron Toews)
Ross Mining (Norm Ross)
Teck Mining Corporation (Gerry Klein)
Torgold Mining (Torfinn Djukastein)

Apologies are extended to placer operators whose properties we were unable to drill because of scheduling changes due to mechanical problems and logistical changes.

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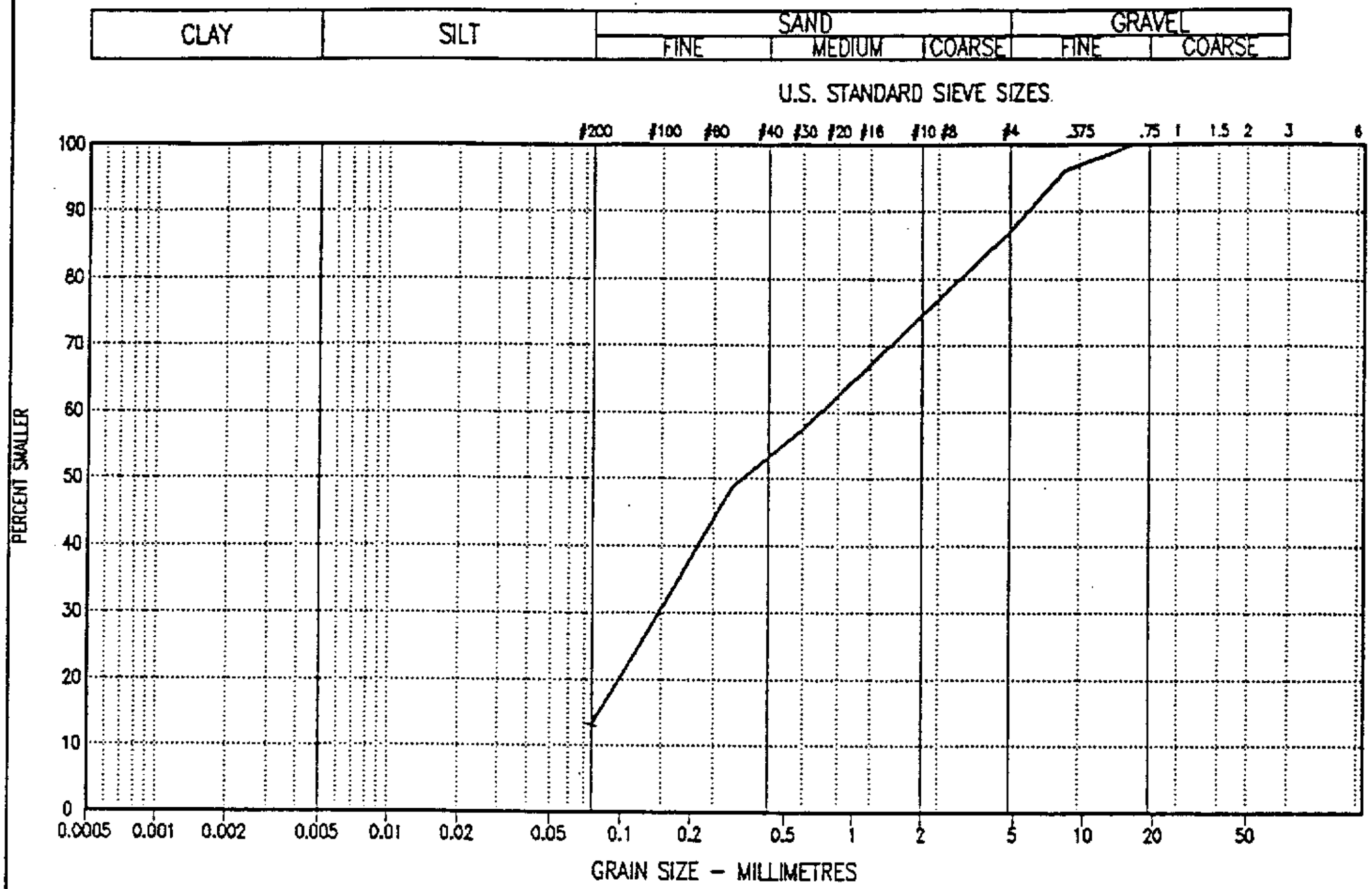
APPENDIX

EBA Engineering

PARTICLE SIZE – ANALYSIS OF SOILS



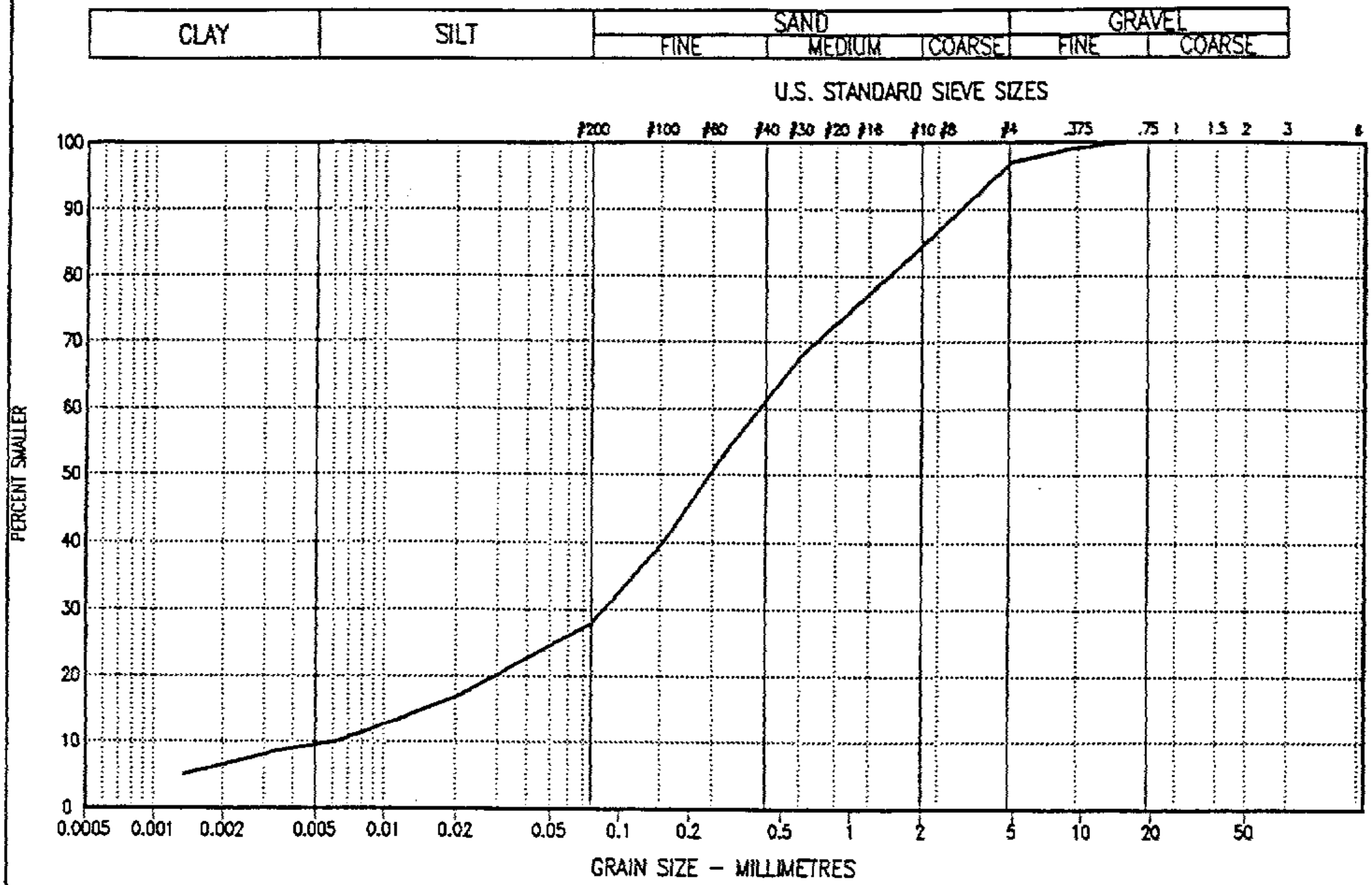
SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION CLAY & SILT %	SAND %	GRAVEL %	Cu	Cc	U.S.C
——	94–GH–02 (A-2)	6.00 – 9.00	13.4	73.6	13.0	2169.7	0.0	SM

Project: 0201–11640 Date Tested: 94/11/05 BY: ATM

Tested in accordance with ASTM D422 unless otherwise noted.

EBA Engineering

PARTICLE SIZE - ANALYSIS OF SOILS



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———	94-WC-02 (C-2)	18.00 - 20.50	9.2	18.7	68.7	3.4	67.7	2.9	SM

Project: 0201-11640

Date Tested: 94/11/12

BY: ATM

Tested in accordance with ASTM D422 unless otherwise noted.

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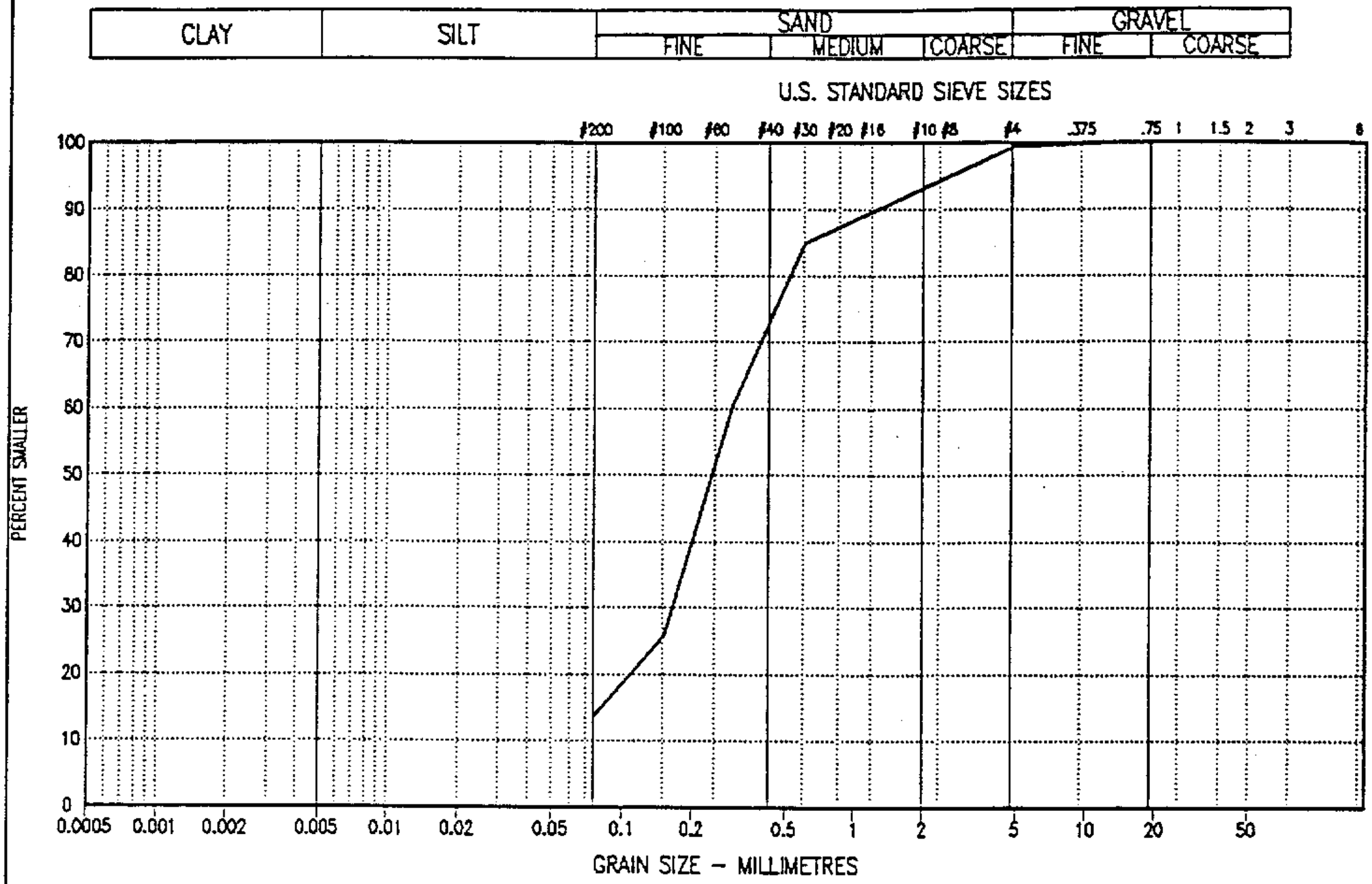
PARTICLE SIZE – ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION CLAY & SILT %	SAND %	GRAVEL %	Cu	Cc	U.S.C
——	94-GR-02 (D-2)	12.00 – 15.00	13.6	85.6	0.8	5.4	1.8	SM

Project: 0201–11640

Date Tested: 94/11/03

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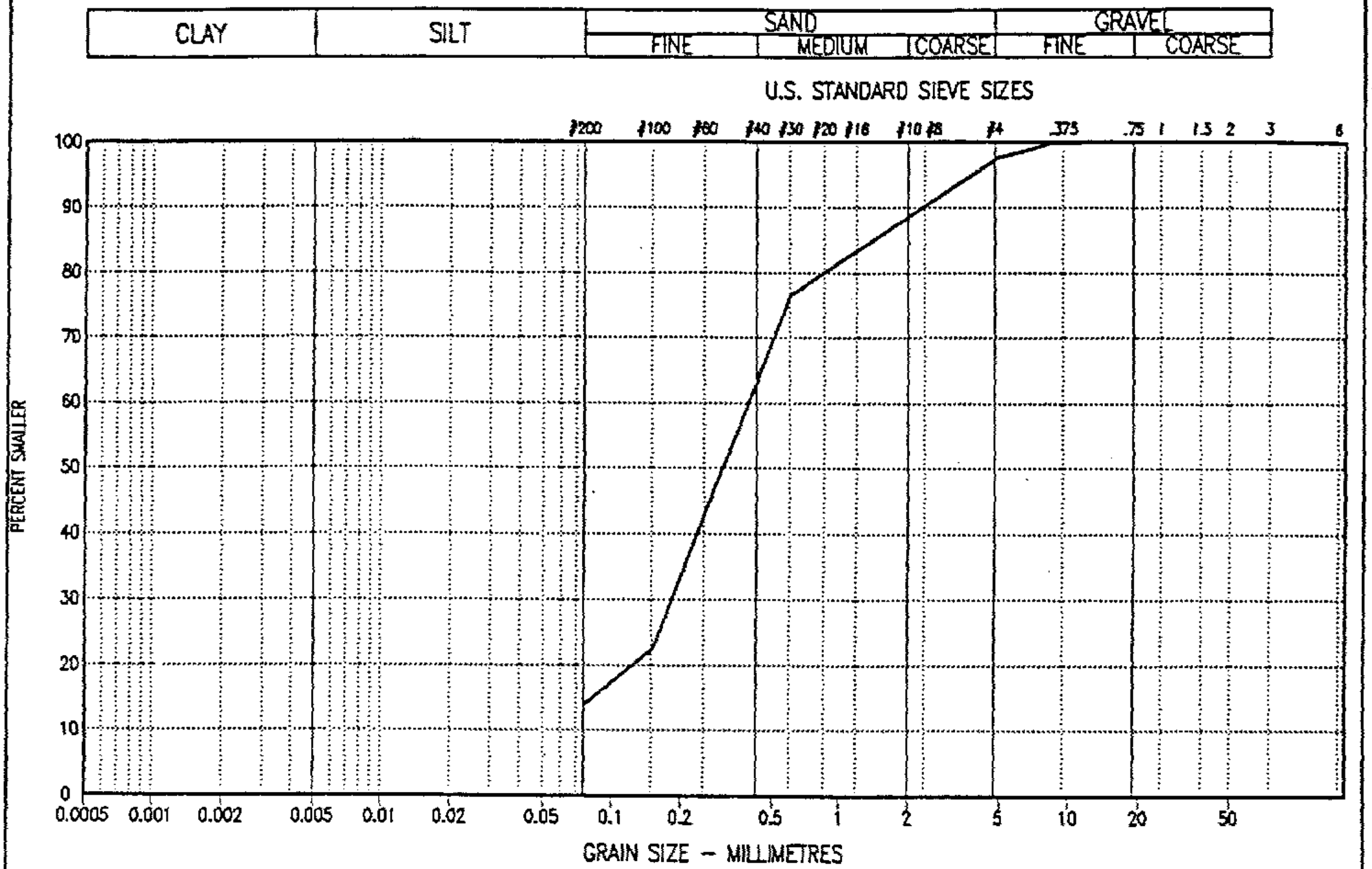

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——	94-GR-02 (D-2)	21.00 – 24.00	13.8	83.4	2.8	7.6	1.6	SM

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Date Tested: 94/11/06

BY: ATM

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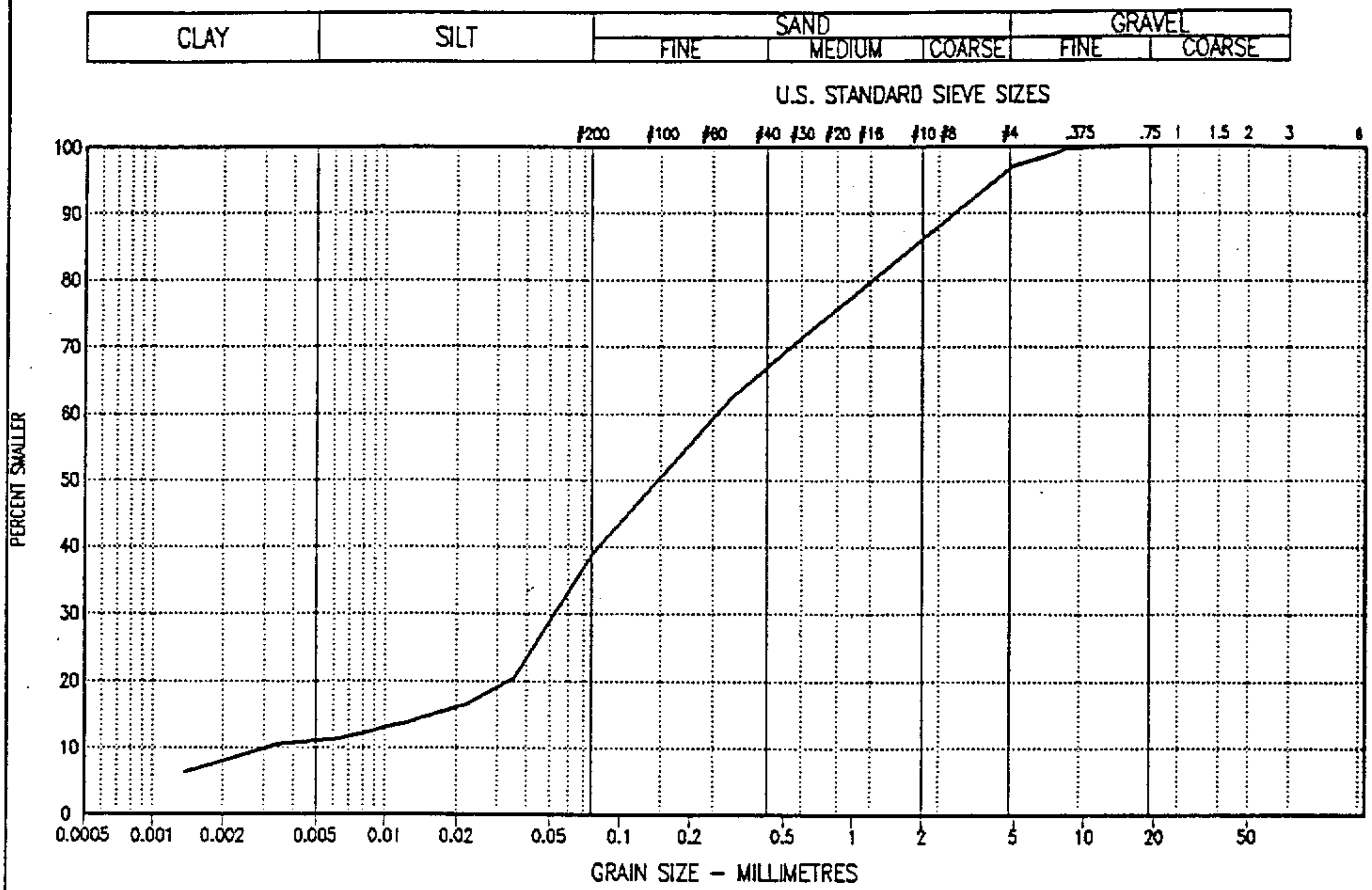

SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION CLAY %	SILT %	SAND %	GRAVEL %	Cu	Cc	U.S.C
——	94-SC-01 (E-1)	16.00 – 20.00	10.8	28.0	57.8	3.4	86.1	3.7	SM

Project: 0201-11640 Date Tested: 94/11/07 BY: ATM

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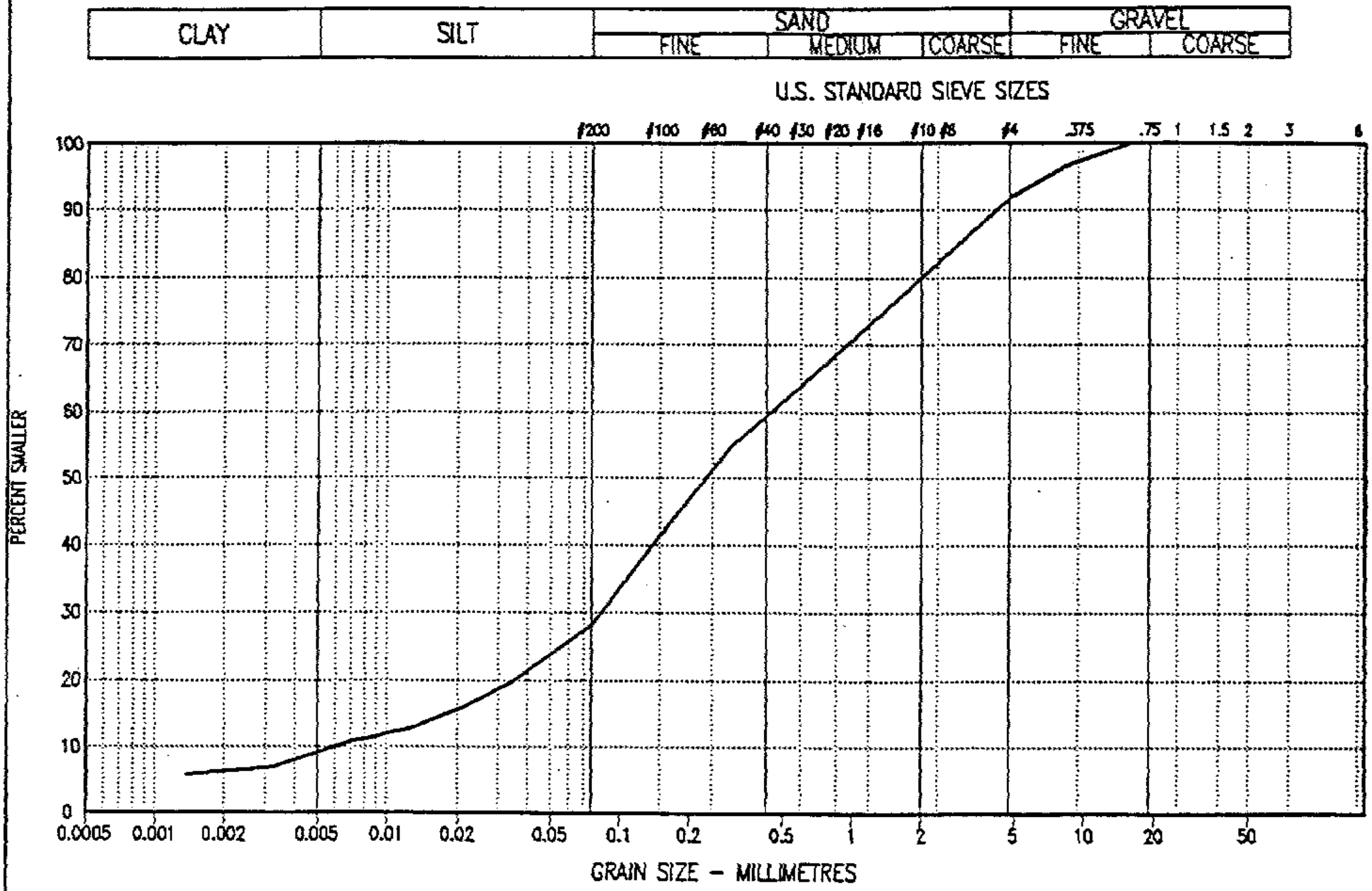
PARTICLE SIZE - ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (ft)	DESCRIPTION CLAY %	SILT %	SAND %	GRAVEL %	Cu	Cc	U.S.C
——	94-SC-01 (E-1)	23.00 - 26.00	8.8	19.3	63.6	8.3	77.6	2.5	SM

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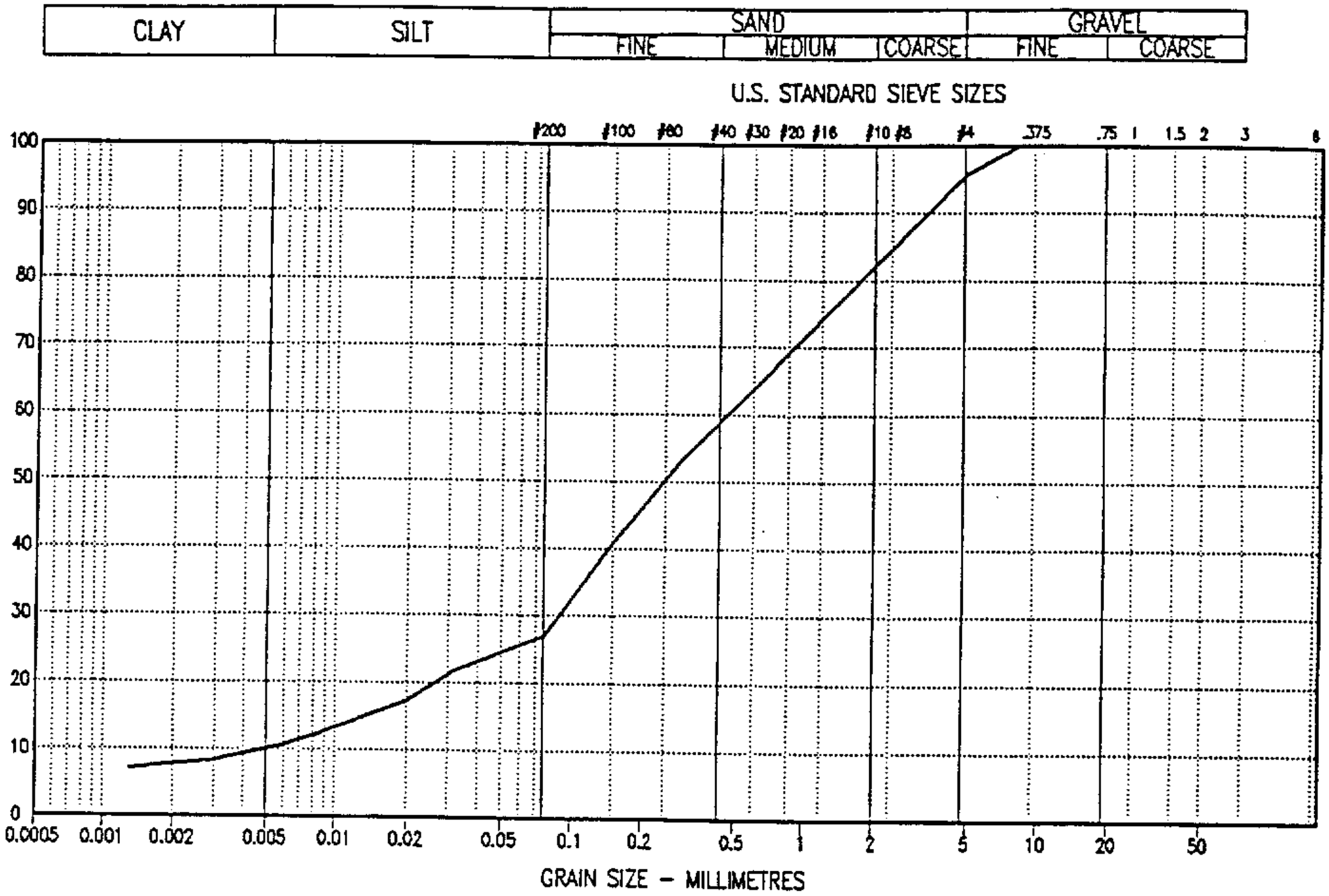

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——	94-SC-01 (E-1)	26.00 – 29.00	9.8	16.9	68.7	4.6	92.7	3.3	SM

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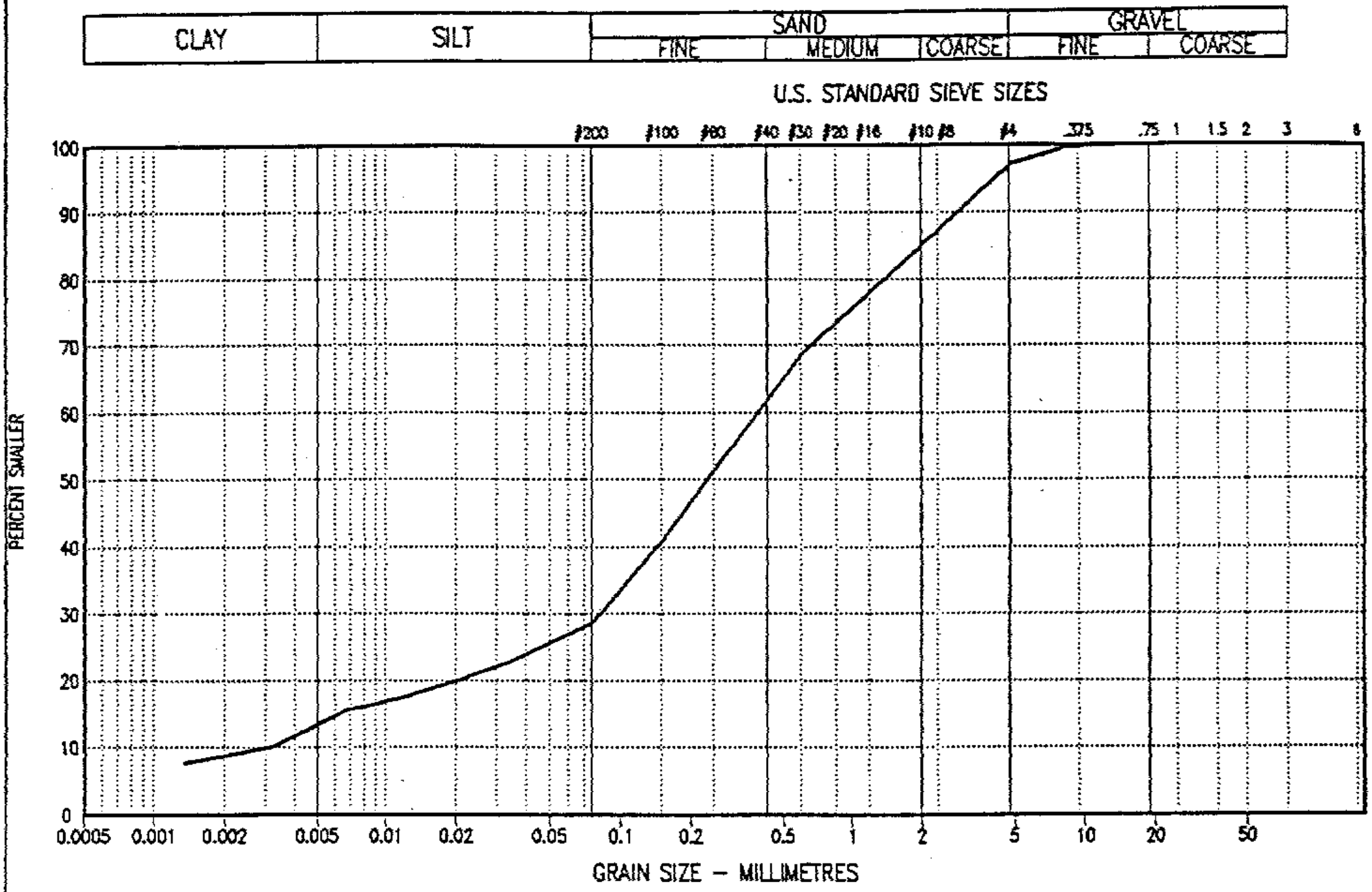

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———	94-IR-02 (G-2)	6.00 - 9.00	12.9	15.6	68.4	3.1	132.4	5.5	SM

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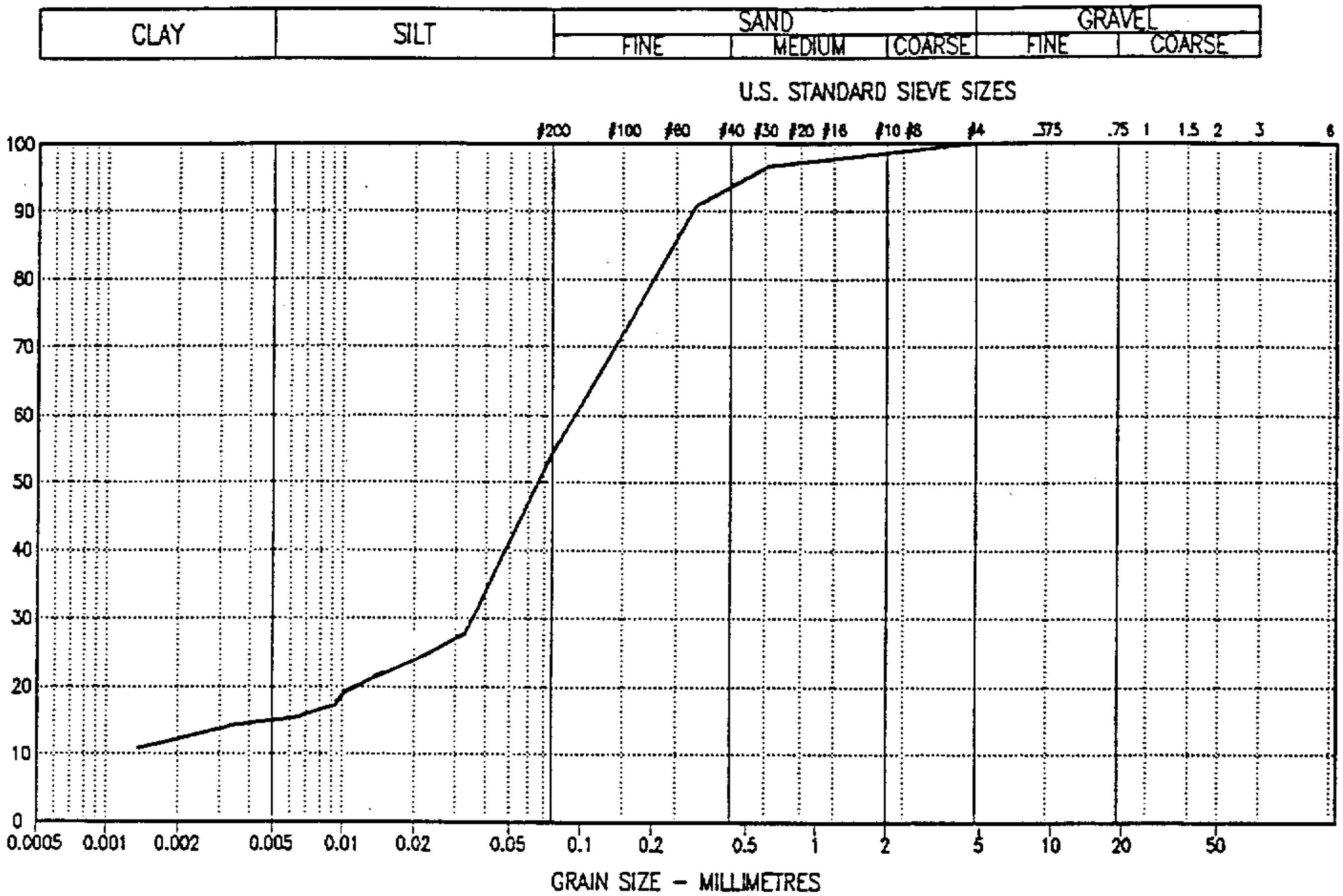

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——	94-EC-02 (H-2)	15.00 – 20.00	14.8	39.7	45.3	0.2	-	-	

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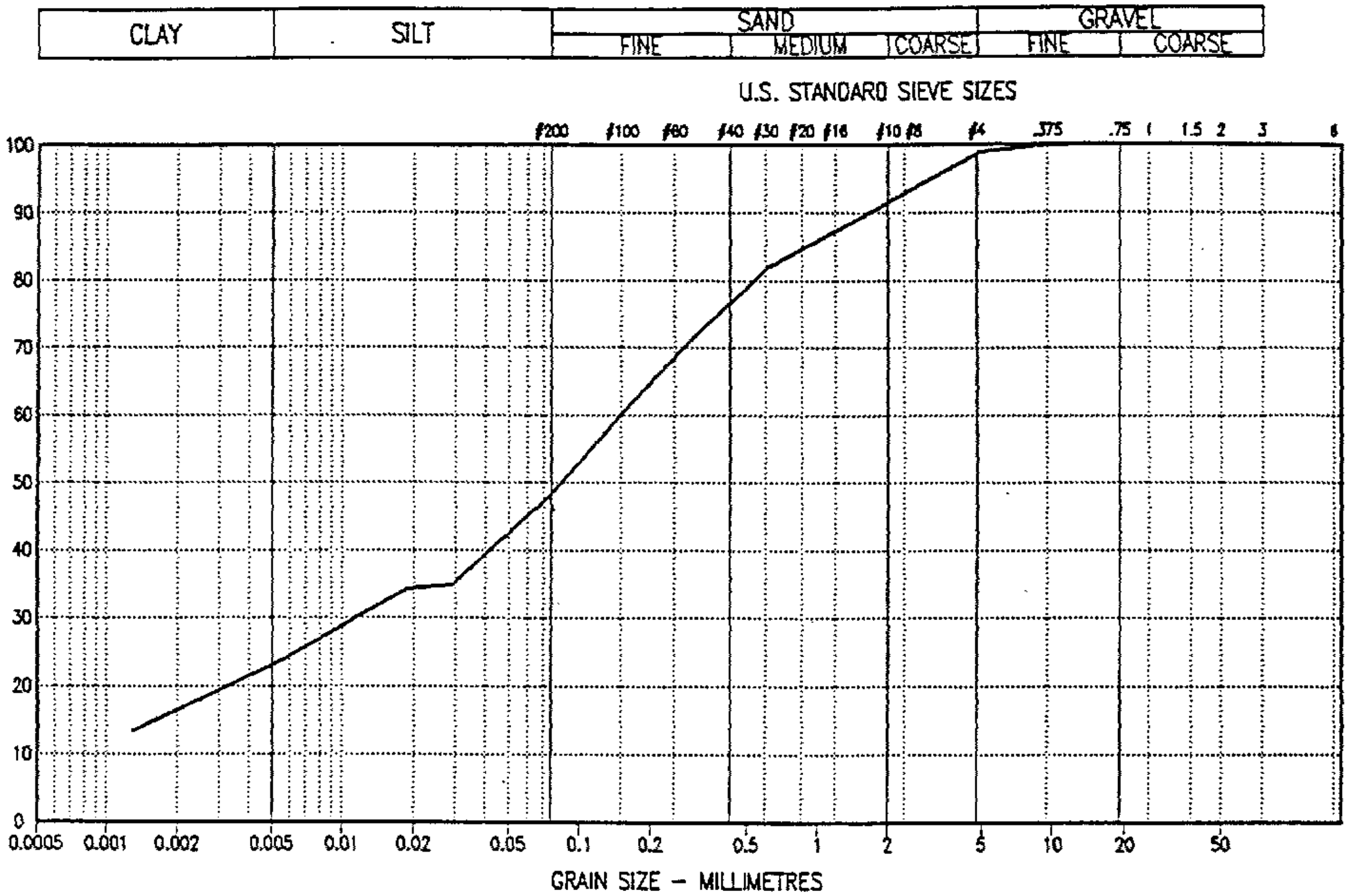

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			CLAY %	SILT %	SAND %	GRAVEL %			
——	94-EC-02 (H-2)	30.00 – 31.00	22.7	25.5	50.3	1.5	–	–	

Project: 0201-11640   Date Tested: 94/11/14   BY: ATM

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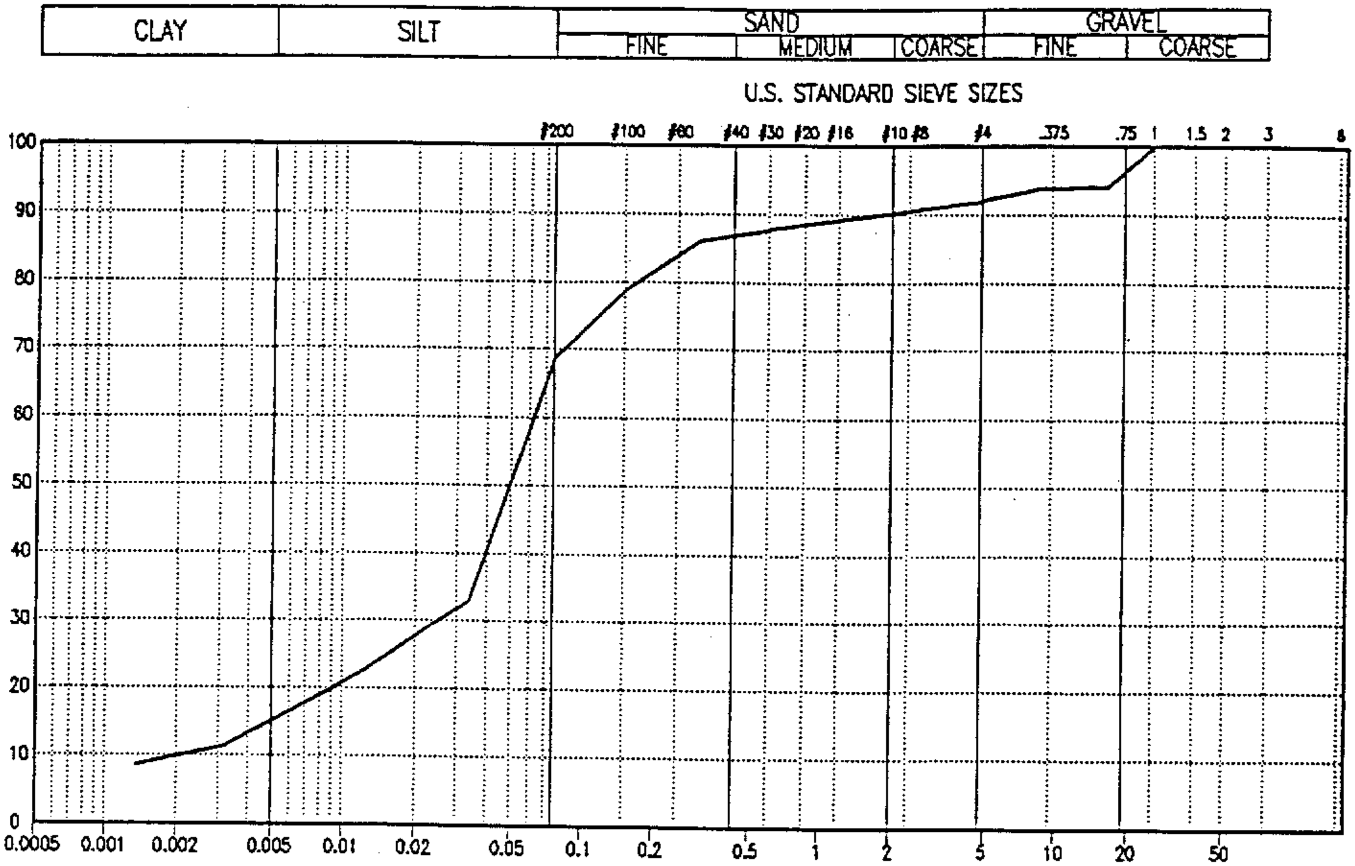
PARTICLE SIZE – ANALYSIS OF SOILS



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———	94–OC–01 (I-1)	12.50 – 15.00	14.5	54.0	23.3	8.2	28.1	4.4	

Project: 0201–11640

Date Tested: 94/11/07

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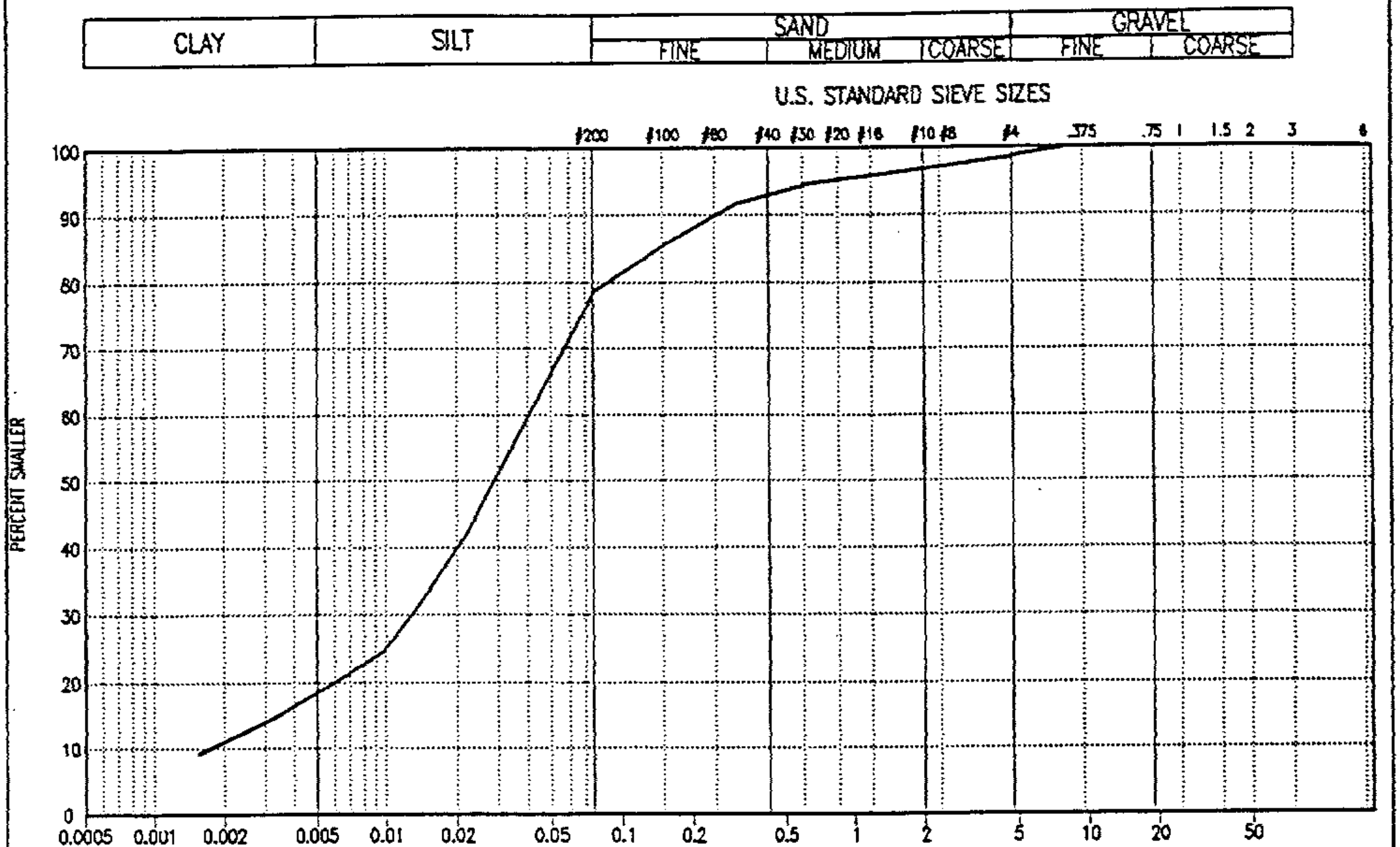
PARTICLE SIZE – ANALYSIS OF SOILS



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———	94-OC-01 (I-1)	19.50 – 25.00	17.8	60.6	20.0	1.6	24.6	2.0	

Project: 0201-11640 Date Tested: 94/11/14 BY: ATM

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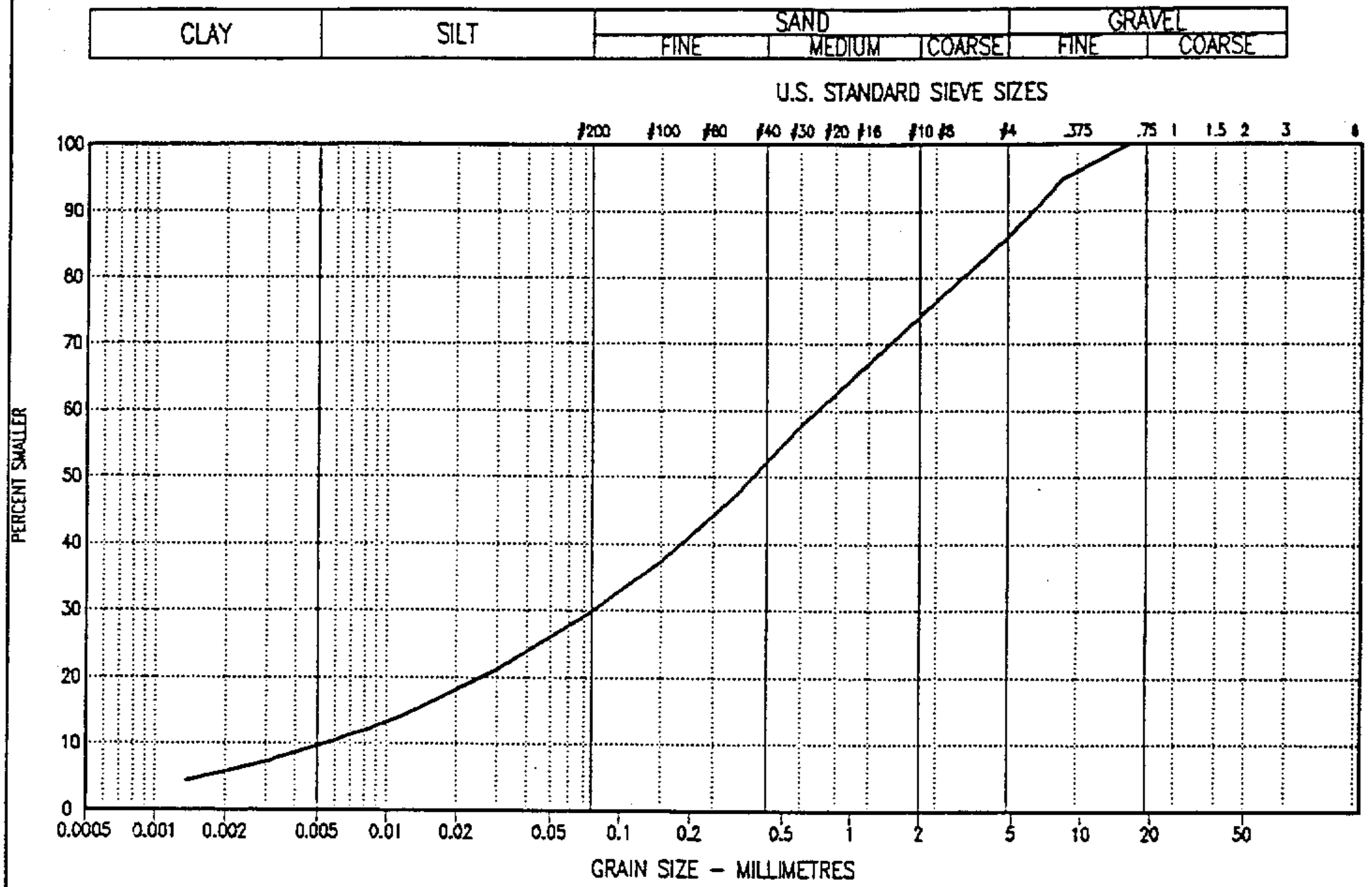
PARTICLE SIZE - ANALYSIS OF SOILS



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———	94-MD-01 (J-1)	10.00 - 15.00	9.3	20.5	56.2	14.0	17341.2	0.0	SM

Project: 0201-11640

Date Tested: 94/11/12

BY: ATM

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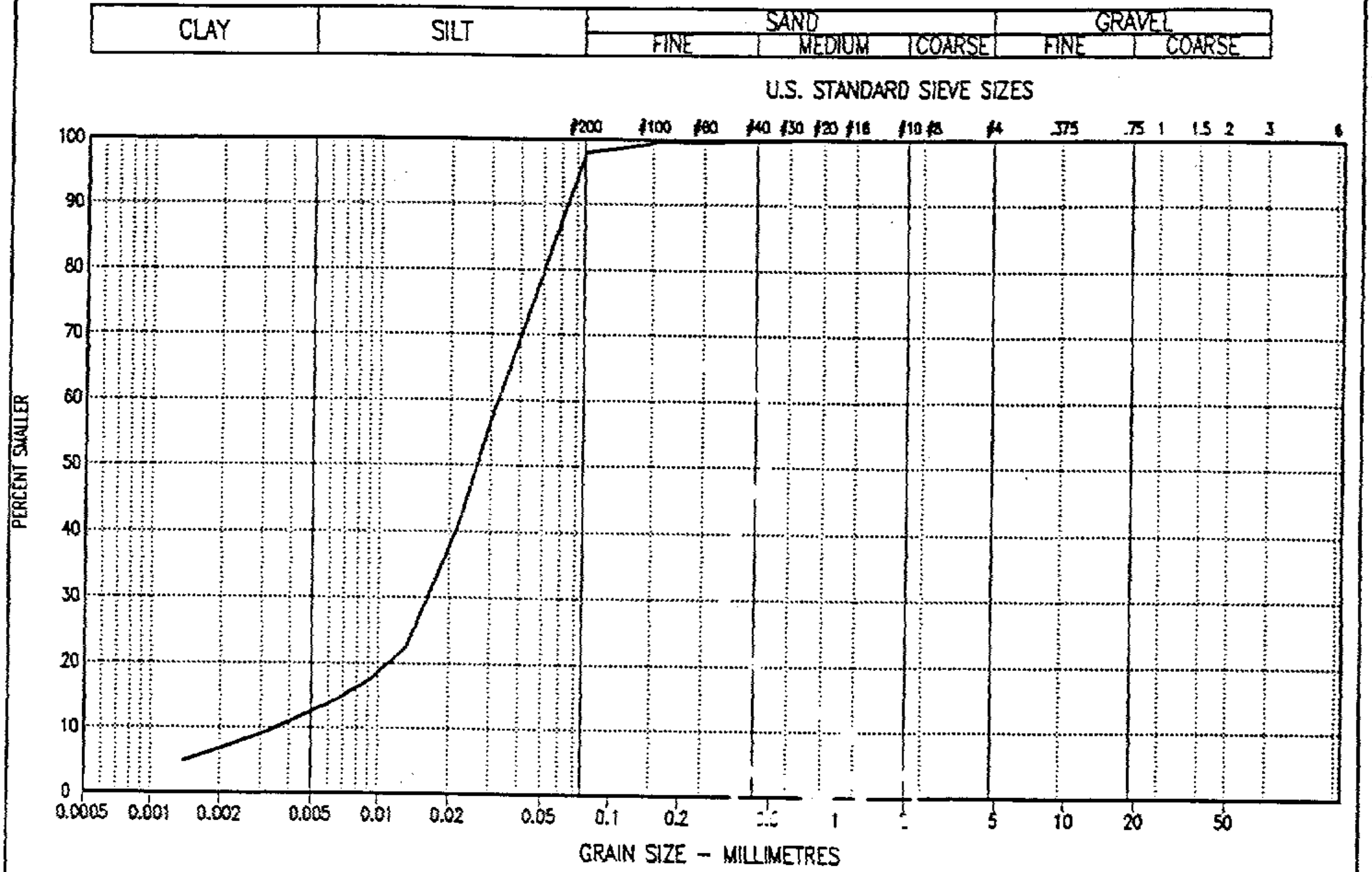
PARTICLE SIZE – ANALYSIS OF SOILS



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———	94-MD-01 (J-1)	0.00 - 5.00	12.0	85.5	2.5	0.0	9.0	2.3	

Project: 0201-11640 Date Tested: 94/11/12 BY: ATM

Tested in accordance with ASTM 0422 unless otherwise noted.