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PELLY RIVER PROJECT REPORT, AUGUST, 1966

Submitted by:

Clyde L. Smith.

KERR ADDISON MINES LIMITED

(FOR INTER-OFFICE USE ONLY)

DEC 6 1966

To Mr. P. M. Kavanagh *From* W. M. Sirola

Subject Pelly River Project 1966, Clyde Smith Report *Date* December 1, 1966

W.S.R.
K.C.G.
J.H.S.
E.F.
R.D.S.
B.C.B.
P.M.K. ✓
G.W.M.
R.G.M.
C.K.W.
J.B.S.
G.P.R.
K.F.L.
J.J.B.
E.C.J.

The enclosed report which we had submitted rather piecemeal is not exactly a thing of beauty, but does contain a fairly good compilation of the information accumulated during the 1966 season. We did what we could with the maps that were submitted to us, but they are not in the form in which we would prefer to have them. We have, however, put co-ordinates on all of the sheets because these were almost entirely lacking when they were received here.

At the beginning of the exploration season, Dr. Delavault really did not have the proper procedure for regional geochemical studies. He seemed to feel that one could only hope to work with active stream sediments or try to sample the slopes immediately below the tops of the hillsides. I pointed out to both Delavault and Smith the work that had been done at Vangorda and after visiting both the Vangorda and the Faro deposits, they decided that seepages were very important in regional geochemistry of that particular part of the Yukon. This at least gave us an added procedure which permitted coverage of areas which could not be properly sampled by the usual techniques. I will be the first to concede however, that the interpretation and pursuit of hydromorphic anomalies can be difficult. I can only suggest that these anomalies should be quite strong before too much time is spent in testing them further.

Clyde mentioned that they had to discontinue the use of the cold heavy metals kit in the field because strong anomalies obtained with this kit proved to contain anywhere from 5 to 600 ppm when analysed by hot acid techniques in the lab. I confronted Delavault with this and he advised me that the cold techniques need not have been discontinued despite these results. I disagree with his answer and suggest that the whole problem arose from the use of a contaminated buffer solution.

Appended to Clyde's report is a report by John Ogden describing the lab set up, the nature and quantity of chemicals involved and the analytical techniques used. I was somewhat taken aback however, when I realized that he was calling aqua regia "aqua reagent". The term "water reagent" is new to me.

There is nothing in the report which really indicates much justification for further work on the Davie group. I am still quite prepared to write it off on the basis of the evidence collected to date, but we should at least have a look at the Kay group.

(continued page 2)

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To .... From ....

Subject .... Date ....

Neither the Ram group nor the Mac group were properly evaluated but this is now water under the bridge. I would not recommend paying out cash in lieu of work for either group.

I believe that despite the personnel problems which arose on this project, the area as a whole was fairly well evaluated and I think that Clyde's geologic work was good. Other than perhaps going to the expense of air borne EM work, we did pretty much all that could be done in that terrain and we certainly learned something about the use of geochemistry in the Yukon.

W. M. Sirola

W. M. Sirola.

WMS/lk
Encl.

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INTRODUCTION

During the winter of 1965-1966, it became apparent that Dynasty Explorations and other exploration companies were undertaking extensive airborne magnetic and electromagnetic surveys in the Vangorda-Swim district of central Yukon. Because this region was of great exploration interest to the Company and because it was felt that valuable areas may be lost to competitors, a two-phase exploration venture was promptly organized. The first phase was an airborne magnetic survey of geologically favorable regions northwest and southeast of the Vangorda-Swim district which was carried out in March, 1966. The second phase was a program of combined magnetic anomaly evaluation and regional geochemistry-geology undertaken during the summer of 1966.

The choice of areas for exploration was based on the concept that such areas should have the basic structural features of apparent significance found in the Vangorda-Swim district. The first step in such a choice required the development of a cogent genetic interpretation of the Vangorda ore-body as well as relating data from the Dynasty and Swim Lakes ore-bodies. Cross-sections of diamond drilling and regional structural sketches were made of Vangorda. From the cross-sections, it was apparent that mineralization is located at a point of sedimentary facies change from quartz-sericite schist on the northeast to quartz-graphite schist on the southwest - the location of mineralization probably being dependent on the chemical barrier imposed by the graphitic material on hydrothermal solutions migrating from the northeast. Structural sketches of the district show the following features in order of importance: location northeast of the Tintina Fault (known deposits 6 - 10 miles from fault), country rocks of low-grade silicic meta-volcanics and interbedded graphitic schists, presence of northeasterly-striking cross faults near ore bodies, presence of granitic intrusives with 1 - 2 miles to northeast of ore bodies, occurrence along southwest limb of major anticline striking east-west and meeting Tintina Fault at acute angle, and occurrence of east-west trending magnetic belts possibly indicating hinge lines or lines of facies change along which mineralization is present.

The choice of areas for further exploration was made by attempting to find structural characteristics similar to the above in neighboring areas. Two areas were chosen as high priority on this basis: the Little Kalzas Lake area (Area #1) and the Mink Creek area (Area #3). A third area (Earn River Area #2) was contemplated for some airborne work even though it lacks granitic intrusives.

AIR MAGNETIC PROGRAM, MARCH, 1966

INTRODUCTION:

A month-long program of air magnetics and subsequent anomaly staking was carried out in areas northwest and southeast of the Vangorda-Swim district during March, 1966. The crew consisted of a helicopter pilot, helicopter mechanic-cook, electronics technician, and a geologist-party chief. The instrument used was an Elsec magnetometer with Texas recorder mounted in a Hiller 12E helicopter; magnetometer head was located at the end of an aluminum boom projecting ahead of the aircraft about 13 feet. Survey procedure consisted of flying 1/4 mile-spaced line traverses perpendicular to regional strike at average elevation of 350 feet above ground and average speed of 40 - 50 miles per hour.

Two base camps were established: one on the west shore of Little Kalzas Lake and one on the south shore of Sirola Lake. The camps consisted of one 14 x 16½ tent on a wooden frame for four men. Separate tents were used for staking crews. The project was serviced by Great Northern Airways from Whitehorse.

During 14 days of flying, 1,663 line miles were covered in a total time of 44:20 hours for an average of 38 miles per hour.

It was discovered late in the project that a switch regulating recorded magnetic intensities had been mis-set since the beginning of the flying. This caused a re-flying of a large part of the Mink Creek area and a complete re-evaluation of results obtained in the Little Kalzas Lake and Earn River Areas. The re-evaluation prompted a return to the Little Kalzas Lake area to stake the Ram group. The Mac group in the

Earn River area had previously been staked although recorded magnetic intensities had been originally regarded as unusually low.

LITTLE KALZAS LAKE AREA (AREA #1)

A total of 386 line miles were flown between March 8 - 13 in the Little Kalzas Lake Area. Figures 2 - 4 are air magnetic maps made by plotting flight line data (scale intensity increased 10 times to compensate for mis-setting of Elsec) on air photo mosaics of scale 1" = 2,000'. Due to the fact that the Elsec recorded intensities 1/10 the proper intensity during the flying of this region, a large magnetic anomaly southeast of Little Kalzas Lake was staked, but not recorded, as the Tom group. A traverse across the anomaly revealed schistose greenstones in outcrop - the probable cause of magnetics - although the staking was predicated by the apparently lower magnetic intensity which could logically have been mineralization.

A second group of 40 claims was staked late in the project and recorded as the Ram group. The group lies about 7 miles northwest of Little Kalzas Lake and covers a broad sinuous magnetic anomaly with four separate peaks of 200 - 300 gamma relative intensity. The Ram anomaly is part of a still larger magnetic belt which trends northwest-southeast along the northeast side of the Tintina Fault. Portions of this belt are composed of anomalies of a broad-moderate intensity character which warrant further investigation; other portions are composed of small - high intensity anomalies (some of which form limited continuous belts) which probably overlie formational units.

EARN RIVER AREA (AREA #2)

A total of 486 line miles were flown between March 14 - 19 in the Earn River Area. Figure 5 is an air magnetic map of the northwest portion of the area, where the only significant anomalies were found. Again, plotted intensities are 10 times greater than recorded values to compensate for the mis-setting of the recorder.

A group of 48 claims were staked and recorded (Mac group) on a broad magnetic anomaly just north of the MacMillan River, about 6 miles southeast of Kalzas Mt. The staked anomaly is a portion of a larger belt of scattered, low-intensity anomalies. Peaks within the Mac anomaly range from 200 to 450 gammas in relative intensity. One outcrop examination on the anomaly revealed gray phyllite with no magnetite content. The anomaly occurs at a contact between units 15 and 19 of the G.S.C. Glenlyon sheet.

MINK CREEK AREA (AREA #3)

A total of 581 line miles were flown between March 22 - 26 in two portions of the Mink Creek Area within which anomalous magnetic belts are shown on G.S.C., one-mile scale, aeromagnetic series maps. Figure 6 is an index and location map for the region. It was found that the general slope and location of magnetic anomalies shown on the government maps can be relied upon. Lower elevation flying provided detail in the shape of anomalies and it was found that relative gamma intensities on government maps could be multiplied by 3 - 4 to make them correspond to lower elevation intensities.

The southern magnetic belt investigated lies about 1 - 8 miles from the Hoole River (Tintina Fault) and intersects the Hoole at an acute angle at Starr Creek. Four sinuous anomalies ranging in maximum intensity from 250 - 350 gammas were detailed and three were staked and recorded. The claim groups are the Cher (24 claims), the Nan (48 claims), and the Mar (32 claims) and they lie just north of an east-west trending series of lakes between Hoole River and Mink Creek, about 13 miles south of the Pelly River. Outcrop was checked at two points within the claim groups and found to consist of interbedded crystalline limestones and carbonate-bearing greenschists with disseminated rust-filled voids suggestive of mineralization.

A minor northwest-trending magnetic belt just north of the Pelly River (termed the Sam Lake Area) was also flown in Area #3. Four small anomalies were detailed which ranged from 150 - 200 gammas in maximum relative intensity. An outcrop check immediately northwest of the most westerly anomaly revealed gabbro, however, and it was believed at the time that the gabbro was adequate explanation for the magnetics. No claims were staked in this magnetic belt.

ANOMALY EVALUATION AND REGIONAL GEOCHEMICAL PROGRAM SUMMER, 1966

INTRODUCTION:

A combined program of magnetic anomaly evaluation and regional geochemistry was undertaken in the summer of 1966. A base camp was established along the Watson Lake - Ross River road near where it crosses Mink Creek. The crew consisted of a geologist-party chief, three student geologists, three student assistant geologists, a laboratory geochemist, helicopter pilot and mechanic (Klondike Helicopters) and a camp cook.

The program was mainly one of geochemical sampling and outcrop examination with geophysical follow-up work in areas of anomalous geochemistry. The Mink Creek area was chosen to receive the bulk of the work because three claim blocks were located in the area, government airborne magnetic maps were available, and the structural geology of the area bears a stronger resemblance to the Vangorda-Swim district than most other areas in central Yukon.

The program consisted of three methods of attack in the Mink Creek area: surveys of the Nan, Mar and Cher claim groups, surveys of areas of anomalous magnetics shown on government maps, and surveys of geologically favorable areas as determined by reconnaissance geologic mapping.

FIELD GEOCHEMISTRY

Dr. R. E. Delavault, geochemist from the University of British Columbia, was with the project for the first two weeks of the season; he set up the field laboratory and consulted on collecting technique. A considerable debate was carried on between Delavault and myself as to the nature of metal dispersion, and the best collecting techniques to be employed, in the Mink Creek area. Early in the field work, Delavault believed that dispersion takes place almost exclusively by transportation of detrital particles and that unless sampling is conducted on suboutcrop or in active stream sediment, results are inconclusive. He stated that attempts to sample areas of greater than 100 feet of glacial cover are almost futile. This approach appeared to be a repudiation of the concept of hydromorphic dispersion - a fact upon which the geochemistry of the program was strongly dependent.

A brief review of geochemistry at Vangorda and a consultation of textbooks showed that hydromorphic or seepage anomalies do occur, and a visit to Faro Creek, which crosses the Dynasty ore body, convinced Delavault that "seepage testing seems to be the answer". At Faro Creek, seven samples were taken and field tested, of active stream silt - nothing more than background results were obtained. Two samples taken from wet soil (below water table) about 2 - 3 feet above the stream in a cut bank gave strong field results for zinc; subsequent lab analysis gave 1400 and 1500 ppm zinc for these samples. It is notable that samples were taken about 1000 feet downslope from the ore-body where it is at a depth of about 300 feet below surface - adequate proof that the zinc had been dispersed in ground waters and reached the surface in seepages, or points of surface emergence of ground waters. Subsequent geochemical sampling in the Mink Creek area was directed primarily toward seepage sampling.

A study of seepages in the Mink Creek area revealed two distinct types: seepages which emerge at the margins of stream flats (or the true surface emergence of the ground water table), and upslope seepages which occur at variable elevations over the area but generally follow a line of consistent elevation in given valleys. In the Hoole claims locale, higher geochemical values were obtained from upslope seepages, however, it is believed that anomalous areas can be adequately detected in stream flats in valleys with minimum slopes of 10 - 15 degrees in which ridge tops are not greater than 1/2 mile from valley flats.

Where seepages are not available, soils were sampled at not less than 500-foot stations along traverse lines. In the Hoole claims area both "A" and "B" horizon samples were taken. It was found that "B" horizon values were consistently higher than those from the "A". Because of this, "A" horizon sampling was discontinued for the remainder of the program. It was also found that wet soils moistened by ground waters invariably give higher values than dry soils.

In summary, it was found that the following locations, in descending order of importance, were suitable for sample collection:

1) Clays or "B" horizon soils from upslope seepages

2) Wet, upslope, "B" horizon soils made wet by ground waters

3) Clays or "B" horizon soils from valley flat margins

4) Active stream silts in tributaries

5) "A" horizon soils in valley flats.

In geochemical sampling traverses, the first four categories were sampled at no greater than 500-foot station spacings. Wherever a higher category material was available it was sampled; furthermore, all tributaries were sampled wherever encountered.

It is difficult to evaluate the influence of permafrost on geochemical dispersion and this remains the great imponderable in Yukon geochemistry. In theory, waters do not migrate through frozen ground, and if water is relied upon as the transporting medium then no secondary dispersion of metals occurs. In practice however, ground water seepages were found in all areas surveyed during the project and it seems reasonable to conclude that if waters emerge at the surface then they are not seriously impeded in their movements through overburden. The question remains, however, as to whether the waters move along upper surfaces of permafrost horizons, or whether they actually penetrate to buried outcrop surfaces, there to acquire loads of soluble metals cations and to transport them to loci of adsorption in the surface environment. My opinion is that in the Mink Creek area the latter is the case. This opinion is based on the following four facts:

1) in given locales the frequency distribution curves for both Zn and Cu analysis correspond to normal curves described in geochemical literature - if permafrost seriously impeded dispersion, it seems that erratic curves might be obtained or that locales would give abundant, low, monotonous values,
2) in all cases where statistically anomalous values were obtained, the anomalies were explained by minor mineralization or graphitic material with apparently high background content - in other words, anomalies are significant and are not caused by the sudden absence of permafrost,
3) during sampling traverses, field crews frequently noted that frozen ground is erratically distributed, suggesting a lack of thick or extensive permafrost,
4) lack of thick overburden which is probably necessary for development of extensive permafrost.

Sampling technique consisted of obtaining the finest clays or silts available at the sample site, either with a trowel at seepages or streams, or with a pick-mattock in soils. Delavault recommended the pick-mattock in preference to a hand auger - his reasons for this were not strong however and it is believed that satisfactory sampling may be done with an auger in places where permafrost is lacking or can be penetrated with an auger. Samples were placed in manila paper envelopes, $3\frac{1}{2}$" x $6\frac{1}{2}$", obtained from Canadian Envelope Co. Ltd., 8205 Montreal Blvd., Montreal West, P.Q. The advantage of these envelopes is that they can be hung to dry prior to lab analysis; this cannot be done with plastic bags.

Sample sites were flagged and a number put on the flagging which corresponded with the number put on the sample envelope as well as in the field notes; type of material and any pertinent remarks about sample sites were made in field books. Sample sites were marked on air photograph overlays. Laboratory results were plotted on overlays also made from air photographs.

FIELD ANALYSIS TECHNIQUE

Field kits for analysis of heavy metals and copper were designed and provided by Delavault. Appendix 1 is a description of the field techniques. The Rubeanic copper technique was found to be reliable and readily duplicated by lab results, however, heavy metal values obtained in the field were not easily duplicated in the lab. Samples which gave the highest order field reaction (pink color) gave lab values ranging from 5 to 1,600 ppm Zn. Field analysis was promptly discontinued when this fact was realized.

REGIONAL GEOLOGY OF MINK CREEK AREA

Figure 14 is a geologic map of the Mink Creek area on a scale of 1" = 4 miles. The area is underlain by a gently-dipping sequence of metavolcanic rocks which lie unconformably on a basement of orthogneisses.

Peridotite and granitic intrusions cut the sequence. The structure is dominated by wrench fault tectonics developed to the northwest of the major structure in the region - the Tintina Fault (a right-lateral wrench fault of over 250 miles displacement). Wrench faulting has imposed a distinctive fracture pattern on the region which consists of three fault sets with the following approximate trends: N45W, N80E, and N20E. The augen-gneiss core of a major dome or anticline is situated south of the Pelly River and younger units dip away from the core to north and south; the dome appears to also be related to wrench faulting.

The following is a brief description of the major rock units in the Mink Creek area.

Augen-gneiss: The oldest rock unit is augen-gneiss which contains variable amounts of large (½" - 2" long) K-feldspar porphyroblasts in a gneissic groundmass. The gneiss appears to be the product of metamorphism of a granitic basement complex. Minor areas of foliated granite occur in this terrane.

Quartz-sericite schists: Lying unconformably on augen-gneiss is a succession of quartz-sericite schists interbedded with minor graphitic schists, chlorite-carbonate schists, and limestones. Portions of the quartz-sericite schist terrane consists of only mildly metamorphosed silicic volcanics. North of the Pelly River the succession was divided into quartz-sericite-biotite schists (underlying), typical quartz-sericite schists, and a sericite-rich member with abundant pure graphite schist interbeds. The entire group appears to be the metamorphosed equivalent of a pile of silicic volcanic rocks of probable ash-flow origin. Folding varies from apparently mild to intense - gently dipping, recumbent minor folds are common - but it is believed that apparently mildly folded rocks are sheared-out equivalents of recumbently folded schists.

Chlorite-carbonate schists: Just north of the Dunsmore fault, a succession of chlorite-carbonate schists lies with apparent conformity on quartz-sericite schist. The rock is typically banded into chlorite-sericite bands and carbonate bands; the entire rock is characteristically rust-coated due to the oxidation of disseminated siderite or ankerite. Schistosity commonly cuts banding at high angles and it appears that the rocks have undergone two periods of deformation and metamorphism. Minor interbedded graphitic schists and crystalline limestones occur scattered in the succession. The schists are the apparent derivatives of andesitic volcanic rocks which were deuterically altered to propylite and subsequently metamorphosed; the banding is probably the result of segregation produced by the earlier metamorphism. Scattered units contain disseminated euhedral magnetite crystals which are the cause of magnetic anomalies in the belt. The Nan, Mar, and Cher groups were staked on such anomalies.

Schistose Felsites: Lying above chlorite-carbonate schists near the Hoole River is a group of mildly metamorphosed schistose silicic volcanics. Portions of the unit consist of feldspar porphyry, felsite, rhyolitic flow breccia, crystalline limestone, and minor graphitic schist. The lack of metamorphism in the unit suggests that it lies unconformably on older rocks.

<u>Granite, granodiorite, quartz diorite, peridotite</u>: Intrusive bodies of probable Cretaceous age cut the stratigraphic sequence. Granitics lie mostly south of the Dunsmore fault and peridotites rim the Mink Creek basin on all sides. The G.S.C. Finlayson Sheet mistakenly shows much of the augen-gneiss of the central Mink Creek basin as granitics. Granites are characteristically medium-grained biotite granites. Peridotites are highly magnetic and contain areas of serpentinization.

Geochemical surveys were undertaken in areas of most desirable geologic setting. Of prime interest were areas near granitic intrusives in quartz-sericite schist country rock broken by faults.

CLAIM BLOCK EVALUATION

RAM GROUP:

Figure 8 is a location map of the Ram group of 40 claims, which is situated northwest of Little Kalzas Lake. Follow-up work consisted of geochem sampling of major drainages in the areas of magnetic anomaly peaks (only a brief evaluation was conducted because all work had to be done out of an overnight camp located about 3 miles from the fly camp). Only background results in Zn, Cu, and Pb were obtained.

MAC GROUP:

Figure 10 is a location map of the Mac group of 48 claims situated on the north side of the MacMillan River, 6 miles southeast of Kalzas Mt. Geology of the group is only crudely known due to lack of outcrop and consists of gray phyllites and graphitic schist in northeast corner of group. Geochem results in all cases except one are of background intensity only - one Pb value is 500 ppm (a re-check in the lab was 450 ppm Pb). The higher Pb value is located just below phyllite outcrop near the center of the magnetic anomaly. The lack of other high values anywhere in the group suggests that this high value is either erratic or caused by a vein of galena. Four reconnaissance lines of EM were run across magentic peaks. An anomaly was recorded with a peak of 26^{o} over a width of about 1/4 mile in the northeast corner of the group; graphitic schist was found in outcrop near the anomaly and is the probable explanation.

It is notable that the cause of magnetics was not explained by examination of outcrop. Also, material collected for geochemical sampling was dry and good seepages were not located. In summary, the evidence to date does not suggest mineralization, however, it is recommended that if possible, the group should be held for more intensive study. A geochemical grid in the area of the 500 ppm Pb, more geochem collecting in the group, ground magnetics, and EM of the anomaly in the northeast corner is recommended.

NAN, MAR, AND CHER GROUPS (Hoole Claims):

Figures 15, 16, and 17, are location maps of the Hoole claims which consist of 48(Nan), 32 (Mar), and 24 (Cher) claims, and are located south of Sirola Lake and east of the Hoole River.

The claims are underlain by a gently dipping sequence of chlorite-carbonate schists with interbedded sericitic units and crystalline limestone lenses. North of the Nan group is an east-west trending normal (?) fault which brings quartz-sericite and graphitic schists into contact with the chlorite-carbonate schists. Magnetite euhedra are common in areas of magnetic anomalies and adequately explain the magnetics. Figures 19 and 20 are EM maps of the claim blocks; two anomalies were outlined but each occurred over graphitic schist in outcrop.

Figure 18 is the geological-geochemical map of the Hoole claims area. Statistically anomalous Zn was taken at 350 ppm and Cu at 130 ppm (see Figure 46). For the area, only two Zn values and one Cu value are statistically anomalous. However, there is a line of eight Zn values of 250 ppm or higher along the east side of a ridge through the Nan and

Red (unrecorded) groups. A detailed sampling of this locale revealed nothing of more significance than previous values. Also, chalcopyrite in a quartz vein was found near the higher readings and is the probable explanation of the values. Quartz and carbonate veins are common in the area although nearly all examined were barren.

In summary, no results of interest were obtained on the Hoole claims and it is recommended that no further work be done.

REGIONAL GEOCHEMISTRY

INTRODUCTION:

Following the Hoole claims evaluation, the project was mainly devoted to regional geochemistry. Two types of areas were surveyed:

1) Areas of anomalous magnetics as shown on government maps 4, 5, and parts of 6 and 8.
2) Areas lacking anomalous magnetics but having favorable geology: areas 1, 2, 3, and 7.

Area 1:

Area 1 was chosen for geochemical surveying because of its location near the Dunsmore fault, near an intrusive granite body, and due to the presence of quartz-sericite schist host rocks. Furthermore, the area is surrounded by claim blocks (of Atlas Explorations and Riviera Mines) on three sides which suggests potential in the area. The area is underlain by quartzo-feldspathic gneisses and schists which strike northerly and dip 30^{o} to the east.

Figure 21 is the geochemical map of Area 1. Anomalous values were determined at 350 ppm for Zn and 70 ppm for Cu. Two zinc values of 400 and 480 occur southeast of Bob Lake. An outcrop check of this area revealed veinlets and disseminations of pyrrhotite and minor chalcopyrite in gneiss - the probable cause of anomalous values. No further work is recommended in the area.

Area 2:

Sampling was planned for Area 2 but only one stream traverse was conducted. Values are plotted on map of Hoole claims.

Area 3:

Area 3 was chosen for sampling because of the presence of a large expanse of quartz-sericite schist and interbedded graphitic schist located near what was originally believed to be intrusive granite (later study revealed that all supposed granite is augen-gneiss).

Anomalous Zn was taken as 325 ppm and Cu as 90 ppm. A group of anomalous values were found near the southeast end of Mike Lake. Detailed sampling uphill revealed only background values. Magnetics in the area revealed nothing anomalous. Because the original samples are not exceptionally high, it is believed that the area should be of no further interest. Peridotite and graphitic schist (high background rocks) are common to the area and one or the other is the probable cause of the high values.

Area 4:

A single traverse was taken across magnetic anomalies along the Hoole River. Sampled material was of seepage origin. Only one Zn value was considered anomalous and it is probably erratic.

Area 5: Davie Group

See write-up of Davie group below.

Area 6:

Sampling was done east of the Hoole claims along the Dunsmore fault and in the area of magnetic anomalies south of the fault. Magnetics were explained by the presence of magnetite in chlorite-carbonate schists. Zn values greater than 250 ppm were considered anomalous; only four such values were found and none is of significance. Minor chalcopyrite and galena was noted in quartz veins in the area but was of such limited extent as to not be reflected in the geochemistry. No further work should be considered for the area.

Area 7:

Interest in Area 7 began when a bedrock sample taken during a reconnaissance traverse returned a value of 7,000 ppm Zn. Detailed sampling of valleys in the area showed the presence of anomalous Zn and Cu scattered over an area of about $2\frac{1}{2}$ miles in an east-west trend north of Chris Lake (see Figure 28). Follow-up prospecting in the area of grid 1 (Figure 29) revealed no outcrop but detailed geochem sampling returned anomalous values ranging from 510 to 2,500 ppm Zn. Because the values are scattered and follow a narrow linear trend, it is believed that they indicate vein material of probable little significance. Magnetics in the area are negative (Figure 30a); the area appears to be largely underlain by graphitic schist so EM was not done.

Follow-up prospecting in the area south of grid 2 (Figure 30) revealed graphitic schist in isolated outcrops in contact with pyritic schistose volcanics near the southeast end of the area (Figure 28). A peridotite dike bearing minor disseminated chalcopyrite was noted cutting the schistose volcanics - this is the only mineralization known in the area. Geochem sampling in grid 2 (Figure 30) returned anomalous Zn values ranging from 400 to 2,400 ppm and anomalous Cu ranging from 150 to 600 ppm. The high values are located in two short belts - along an east-west creek and along an east-west ridge top to the south. High values in the creek are probably explained by the emergence of seepages, but highs along the ridge most probably indicate mineralization. Bedrock samples from this area ran up to 900 ppm Zn and 200 ppm Cu - not sufficiently high to explain the anomalous values along the ridge top. As of this writing (August 29), it is recommended that a total of six claims be put in to cover the anomalous area along the ridge top in the area of grid 2. Magnetics in the area show no anomalous values.

Area 8:

A few traverses were completed in the area south of Grass Lake near granitic intrusives and east of the Tintina fault. A magnetic anomaly of 180 - 240 gammas was investigated in this area also. An extensive sampling program was planned for this area late in the season but inclement weather in the mountainous region severely retricted progress; most of the area was eventually disregarded and work was done elsewhere. No anomalous geochem results were obtained (Figure 31).

DAVIE GROUP -- AREA 5

MAGNETICS:

Four magnetic anomalies ranging to 150 - 200 gammas in maximum relative intensity were located in the so-called Sam Lake area during the March project (Figure 34). Gabbro was found in outcrop west of Tom Lake and was believed to be the cause of magnetics in the area; no claims were staked at the time.

Subsequent ground magnetics on what was staked as the Davie group (104 claims) defined three anomalies in the western half of the group (Figure 35) of about 400 gammas maximum relative intensity. A detailed survey was made over the anomaly just east of Tom Lake (Figure 43) and an anomaly of 2,000 x 1,000 feet was defined.

In the eastern half of the group, two east-west trending linear anomalies of about 600 gammas maximum relative intensity were located (Figure 36). In the northeast corner of the group, a linear anomaly of about 3,000 gammas intensity probably reflects a basic dike. Also in this area is a broad 1,500 gamma anomaly.

GEOCHEMISTRY:

The first step in evaluation of the airborne anomalies was geochemical sampling around Tom Lake. Maximum values in this area ran 650 ppm Zn, and 220 Cu. Subsequent sampling downstream toward the Pelly River revealed values as high as 900 ppm Zn, and 375 ppm Cu at points of ground water seepage as far as 2¼ mile from the area of superimposed magnetic EM anomalies at Tom Lake.

Traverses across dry soil above the lake shore drew only background results which suggests that anomalous values are derived from seepages. It is notable that the best values were obtained in spots of obvious seepage throughout the area. Although overburden does not appear to be deep in the area, dispersion is believed to be hydromorphic.

It is probable that anomalous values are derived from high background values in the graphitic schist which apparently causes the EM anomaly, however, it is possible that the schist carries mineralization.

E.M.

EM traverses were made across all magnetic anomalies but anomalous EM values were found only in the area of Tom Lake (Figures 38 and 44). The EM anomaly lies across Tom Lake and has two peaks of 31^{o} and 61^{o} - the latter value being highly suggestive of graphite. It is notable that part of the EM anomaly is superimposed on the magnetic anomaly which overlies Tom Lake. The cause of the EM anomaly is believed to be graphite although none is known to outcrop in the immediate area.

GEOLOGY:

No geologic map was made due to a lack of time during the surveying of the group but reconnaissance traverses across the west side of Tom Lake were made. The area appears to be underlain by a succession of flat-dipping schistose volcanics of andesitic-silicic composition. The volcanics are quartz-siderite veined and contain locally abundant disseminated pyrite. Most of the outcrop west of Tom Lake consists of fresh, massive, non-magnetic to slightly magnetic gabbro which is clearly of post-metamorphism age. The lack of air or ground magnetics over this body indicates that gabbro is not the probable cause of magnetics in the Tom Lake locale.

GRAVITY:

A 3,000 x 6,500 foot grid with 500-foot spaced lines was cut over the Tom Lake anomalies (Figure 39) and most of this area was run for gravity by United Geophysics. Results were not encouraging and appear to reflect little more than a regional gradient. Careful contouring, however, reveals the presence of a +.1 milligal anomaly along the east side of Tom Lake, lying roughly over the area of anomalous magnetics and EM. Although the anomaly is of low intensity its position is believed to be of significance, and it may indicate disseminated mineralization.

CONCLUSION:

As of this writing (August 29), the Davie group of 104 claims is being held for a final decision as to whether or not it should be reoorded. It is probable that it will not be recorded for opinions from Dr. Paul M. Kavanagh and W. M. Sirola are now negative. It has been my recommendation however, that because of the presence of superimposed magnetics, EM, low-intensity gravity, and geochemistry anomalies (as well as for transported hydromorphic anomalies), that at least the Tom Lake portion of the group should be recorded. It has been further recommended that the anomalies be investigated by drilling.

Clyde L. Smith.

CLS/lk

DITHIZONE COLD FIELD TEST FOR HEAVY METALS

This test will work mostly as a zinc or copper test, but zinc is a good pathfinder for many types of mineralization where zinc is not the metal being searched for.

Pass into small tube one fourth teaspoonful of soil (about one gram dry soil).

Add enough extracting buffer (citrate or weak acetic) to have some free supernatant liquid after shaking.

To recognize buffers: acid citrate used for copper does not smell; alkaline citrate used here smells of ammonia; weak acetic buffer for zinc smells faintly of vinegar and strong acetic buffer used for copper has the same smell but is offensively pungent.

Make sure that the soil sample is well dispersed in the liquid, eventually break any clay blobs with a small twig or wood sliver. Shake about 15 seconds or 70 strokes.

Add one scoopful (1/2 ml) of pure toluene, and a few drops of dithizone solution (100 milligrs per litre in toluene), usually four drops. Shake as before. Heavy metal reaction will turn the toluene solution pink if citrate buffer is used, and the more zinc the deeper the pink color. If acetate is used, a "mixed color" is obtained, which is, in order of increasing saturation of dithizone by metal: greenish grey - grey - dark purple - light purple - pink.

Such colors may be changed if oxidizing agents turn the dithizone and sometimes even the metal complexes to yellow compounds.

If a pink color shows the reagent is saturated, higher contents may be established by using more drops of dithizone solution, and shaking again, or, preferably by making another test on a fraction of the amount of soil indicated, eventually adding more dithizone too.

When too much iron or other oxidizing agents turn dithizone yellow, it may happen that zinc contents are high, and good results may be obtained then by shaking only a few seconds. Another recommended procedure is to shake a new sample with a somewhat larger amount of buffer and transfer the supernatant liquid to another tube, where it may be shaken with dithizone in the absence of most of the interfering material, or add about 1 milligram per ml ascorbic acid.

In practice, when there is a rusty zone, it is unlikely to be derived from zinc bearing mineralization if one tenth of the standard gram amount does not give a zinc reaction, under the above testing norms.

Buffers: weak acetate (new composition) Half pound (or 250 grs) of sodium acetate (hydrated form) for 30 mls acetic acid and one litre (or one quart) of water.5 mls should not give a reaction with two drops of dithizone and 1 ml of toluene.

Citrate: for two litres (or quarts) take 400 grams (or one lb) of tribasic ammonium citrate, 80 grams of hydroxylamine hydrochloride and enough ammonia to make the pH 8.8, that is to just turn thymol blue from greenish blue to blue. Dilute (usually 1:1) with pure water before use; check like acetate. Buffers which contain zinc are purified by shaking with dithizone solution and eventually (always for alkaline buffers) removing dithizone dissolved in buffer with chloroform.

RUBEANIC ACID TEST FOR COPPER IN SOILS

(Semi quantitative)

PROCEDURE.

Place a strip of rubeanic acid paper 3 centimeters (about 1¼") long in the bottom of a 50 ml. beaker (priferably pyrex glass) or a similar ontainer. Number of assay may be pencilled at one end of paper

Place a 9 cm filter paper circle folded in the usual way so that its point whic must be folded quite sharply rests on the centre of the reagent paper. It may be more practical to reduce the size of the filter a little for a better fit.

Introduce ½ teaspoonful about 2 grams of dry soil), selecting the finest part of the soil, into a 15 ml diameter Pyrex test tube. It is convenient to sort the siil on a little square of onion skin paper, 2" by 2", which is used after to protect the stopper from contamination.

Add acetic acid-acetate solution, usually 3 ml. are enough to thoroughly moisten the séil and leave alittle excess of liquid. Put on stopper. Shake 100 strokes, about 20 seconds. Throw the contents of the test tube into the filter.

If the amount of acetic solution has been properly judged, the liquid will filter slowly without forming a drop at the tip of the filter and the eventually appearing blue black spot of copper rubeanate will be concentrated at one point, wh ere the filter touches the paper.

Unless the filter has been overloaded and too much liquid passes the beaker is then ready again for use. Otherwise, wipe it with filter paper. Same if a very dark and large spot indicates a large amount of copper.

REAGENTS:

Rubeanic acid paper: dissolve rubeanic acid (dithiooxamide), one gram per 100 ml acetone (C.P.); pass strips of filter paper for chromatography, ½ inch wide, 4 feet long, in the solution which has been poured into a shallow porcelain dish. Pin on the edge of a shelf for drying, which takes a few minutes. Utmost cleanliness is reqired. Reagent stains fingers.

Acetic-acetate solution: For a gallon use 1 lb hydrated sodium acetate, and one quart or a litre of C.P. acetic acid. If it does not give a good blank, remove copper by shaking with dithizone solution in carbon tetrachloride.

GEOCHEMICAL TECHNIQUES AND PROCEDURES

BY:
JOHN OGDEN

INTRODUCTION:

The Geochemistry Laboratory was set up under the direction of Prof. R. E. Delavault. The purpose of the lab was the analysis of soil and silt samples for zinc, lead and copper. Equipment was sufficient for a one-man operation. The techniques and procedures outlined are a personal adaptation of basic guide lines and procedures laid down by Dr. Delavault.

LABORATORY SET UP:

The lab was housed in a 16 x 14 tent. The lab layout is shown in Figure 1.

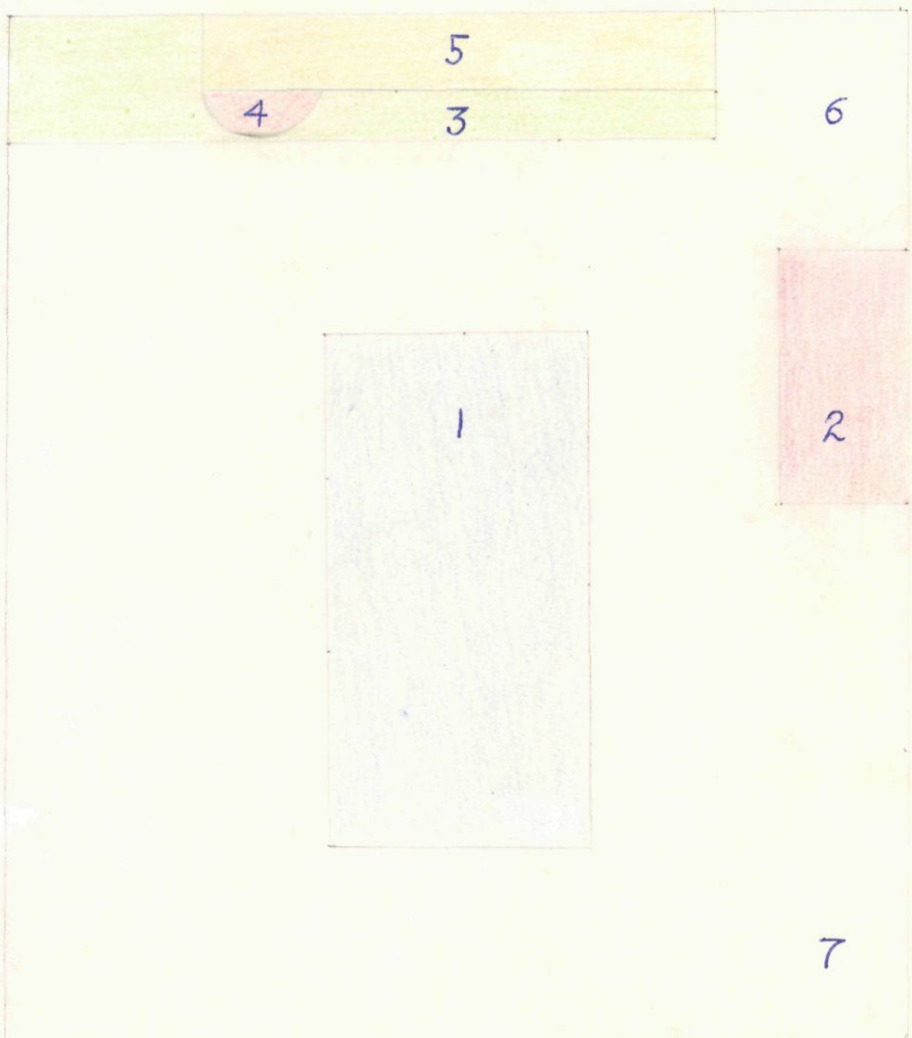


Figure 1-A - Plan View of Lab Scale 1" = 3 ft.

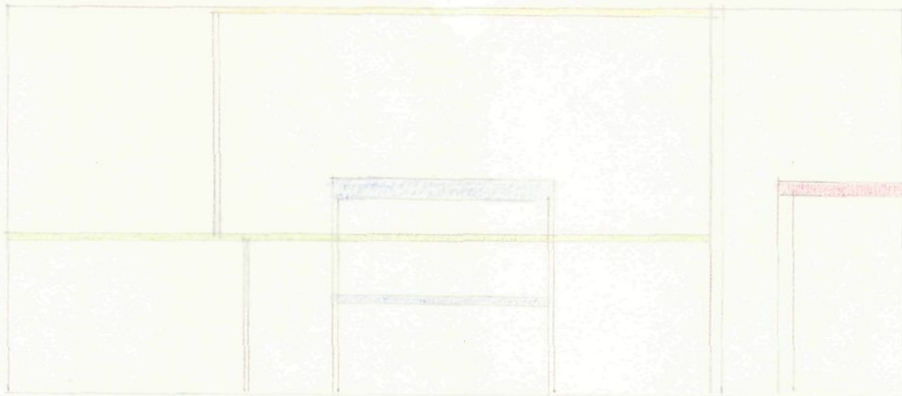


Figure 1-B - End View of Lab   Scale 1" = 3 ft.

1] Main Lab Table - The main lab table was constructed in the centre of the building allowing access from all sides. The table was by 8' by 4' by 3'3". A shelf was built underneath, 1'5" above the floor. This shelf was used for the storage of chemicals and supplies needed in every day work.

2] Small Table - A storage table 4' by 2' by 3'3" was used for the storage of 22 x 180 test tubes while drying and when not in use.

3] Main Bench - This bench was used for washing. Dirty equipment was stored to the left of the sink. Drying and storage while not in use was done on the right side.

4] Sink - The sink was made from the top third of a 45 gal. drum. Drainage was through the wall to a hole outside.

5] Shelf - This shelf was used for the storage of water and some equipment which was used infrequently.

6] This area was used for the storage of samples which had been tested.

7] Samples were hung in this area to dry before being tested.

The layout of the lab is by no means a cut and dried procedure. Variations may be put in to meet the operator's personal desires.

PREPARATION OF SAMPLES:

Samples were collected in heavy paper sample bags and hung on a line to dry. Drying took an average of three days. For accurate results, the samples should be completely dry. The dried sample was put through an 80-mesh sieve. The best method was to use the sieve over a normal sized piece of paper. One gram ($\frac{1}{4}$ teaspoon) of the fine material was put in a 22 x 180 test tube. The remainder of the sample was returned to its bag and stored for future reference. In this step, as in all steps, contamination must be carefully avoided.

The samples were taken out to the fume hood (Figure 2) where 3 ml. of aqua regia * was added. The aqua regia is very reactive and gives off poisonous vapour and should be stored in a glass stoppered bottle in the fume hood. The tubes were then put in a 500 ml. beaker and gradually introduced to the heat provided by a Coleman stove. A cookie sheet gave a good differential heating surface. The samples were cooked until all the liquid was driven off.

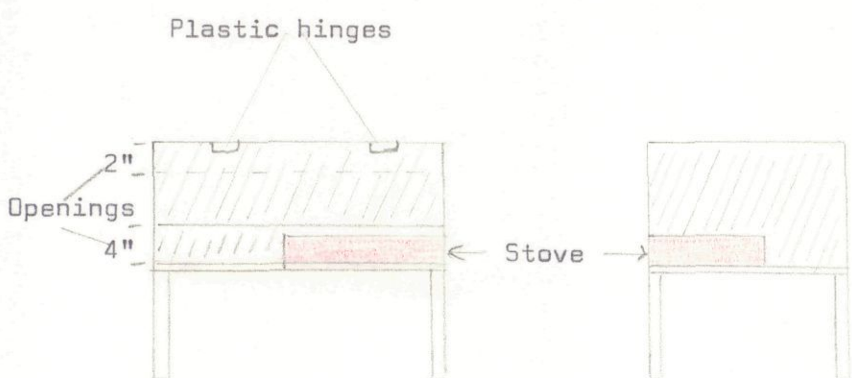


Figure 2 - Fume Hood

* All reagents are listed in Appendix I.

The cooked samples were taken into the lab and 1 ml. of 1:10 hydrochloric acid added. The samples were then allowed to settle for 12 hours or more. After this a few mls. of water was added and by using a glass stirring rod, the solid was scraped from the sides of the tubes and the bottom until all solid was in suspension. The rod was flushed with water and withdraw and the total volume made 20 ml. One must be careful not to withdraw any of the solid or the concentrated liquid on the rod. The diluted samples were left standing until all solid material settled out.

TESTING OF SAMPLES:

1) Copper: Take a 1 ml. aliquot of the diluted sample and transfer to a 18 x 150 test tube. Add 10 mgms of ascorbic acid. (10 mgms can be measured approximately by using a toothpick. About 1/8 inch of the large end is covered.) Add 1 ml. of acetate-citrate buffer to adjust pH to 4.5 - 5.5. Add 1 ml. water. Add 1 ml. of biquinoline. Put a plastic stopper on the tube and shake 100 strokes or 20 sec. Compare the color to that of the standards to determine the copper content.

2) Lead: Take a 1 ml. aliquot of the diluted sample and transfer to a 18 x 150 test tube. Add 10 mgm ascorbic acid and wait a few minutes. Add 1 ml. of citrate buffer to bring pH to approximately 9.0. Add 1/2 ml. potassium cyanide solution. Add 1 ml. of chloroformic dithizone and shake fourty strokes. Compare to standards.

3) Zinc: Take a 1 ml. aliquot of the sample, transfer to 18 x 150 test tube. Add 10 mgm of ascorbic acid and add 10 mgms of hydroxy amime hydrochloride, add 1 ml. of zinc buffer. Add 1 ml. water, 1 ml. of thiosulfate solution. Add 2 mls. Soluene-Dithizone solution, stopper and shake 100 strokes. Compare to standards.

GENERAL COMMENTS ON TESTING:

The addition of the buffers need not be exactly 1 ml. and time is saved by using a 10 ml. pipette. The organic solutions must be exact and a burrette must be used. Also, the aliquots must be measured using a 1 ml. pipette. If the sample being tested produces a color above the range of the standards, a smaller aliquot must be used. Sometimes it is necessary to take a 1 ml. aliquot and dilute it several times and then take a part of that solution before a comparison can be made.

CALCULATIONS:

In general, the following formula is used:

$$\frac{\text{volume of sample}}{\text{volume of aliquot}} \times \text{content} = \text{parts per million}$$

ie - If a 1 ml. aliquot contained 1.5 gammas (gammas = 10^{-6} gm) the sample had ($\frac{20}{1}$ X 1.5) = 30 ppm of the particular metal being tested.

If it was necessary to dilute a 1 ml. aliquot to 20 mls. and a 1 ml. sample of this second solution contained 1.5 gammas the calculations are as follows:

$$\left(\frac{20}{1}\right) \times \left(\frac{20}{1}\right) \times 1.5 = 600 \text{ ppm}$$

PREPARATION OF STANDARDS:

Appendix I outlines the procedure for the storage of standards. The zinc and lead standards must be prepared daily while the copper standards are good for at least a week. The standards were prepared from 100 gammas/ml solutions by making solutions of 1 gamma/ml for zinc and lead and 5 gammas/ml for copper. Enough of this dilute solution was added to separate 15 x 180 test tubes to give the following ranges of standards:

Zinc: B, 0.5 gamma, 1.0 gamma, 1.5 gamma, 2.0 gamma, 2.5 gamma, 3.0 gamma 4.0 gamma, 6.0 gamma

Lead: B, 0.5 gamma, 1.0 gamma, 1.5 gamma, 2.0 gamma, 3.0 gamma, 5.0 gamma

Copper: B, 0.5 gamma, 1.0 gamma, 1.5 gamma, 2.0 gamma, 2.5 gamma, 3.0 gamma 4.0 gamma, 6.0 gamma, 10.0 gamma, 15.0 gamma, 20.0 gamma.

B = Blank (no metal)

These standards were individually tested for their content (ie, lead for lead, zinc for zinc) using the same procedure as used for testing the unknown samples. The standards should range in color as follows:

Zinc and Lead: Green --- Red as concentration increases

Copper: Blank --- Red as concentration increases. The copper standards have only one color involved; with the intensity of the red increasing as the copper increases.

Water: All water used must be free of the metals and must be clear. If stream water is unsuitable, snow can be melted if available or else de-ionization must be carried out.

GENERAL SUGGESTIONS AND AIDS

1) All equipment should be washed in a solution of 1:3 hydrochloric acid.

2) Tubes and equipment are best washed by using a squeeze bottle. If water is scarce, three or four rinsings with a little water is the most proficient method.

3) More work can be done if a proper routine is set up.

4) The 22 x 180 test tubes were marked by a file at the 20 ml. mark.

5) If the standards do not come out as expected, the reagents used should be checked for contamination or deterioration.

6) A conversion for using measuring spoons to weigh reagents is given in the back of the record book used this summer.

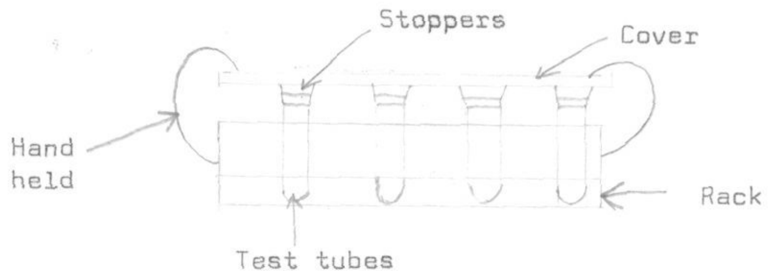
7) Contamination, spillage must be avoided.

8) Equipment supplied was satisfactory, but the following would be advisable additions:

   1 50 ml. burette

   4 test tube racks (2 for each size)

9) By using trays, tests can be done in groups of 24. Shaking is accomplished as shown:



10) All test tubes should be marked to enable identification of sample being tested.

REAGENTS NECESSARY FOR 1,000 TESTS -
Assuming approximately 50 tests per day.

Nitric acid	400 ml.
Hydrochloric acid	800 ml.
Biquinoline	0.25 gm
iso-amyl alcohol	1200 ml.
ammonium citrate	1000 gm.
Sodium Acetate	500 gm.
Acetic acid	75 ml.
Potassium Cyanide	125 gm.
Sodium Thiosulfate	75 gm.
Toluene	1500 ml.
Chloroform	3000 ml.
Hydroxylamine Hydrochloride	110 gm.
Ascorbic acid	20 gm.
Dithizone	.250 gm.
Acetone and Hydrochloric Acid	1 bottle of each for cleaning purposes.
Standards	.250 gm. Cu, Zn, Pb.
Ammonium Hydroxide	500 ml.

PREPARATION OF REAGENTS

1) Aqua Regia:

3 parts Hydrochloric Acid to 1 part Nitric Acid.

2) Biquinoline Solution: 0.02% in n-amyl or iso-amyl alcohol.

a) 0.1 gm Biquinoline in a 250 ml. volumetric flask

b) Add iso-amyl alcohol to 250 ml. mark.

c) heat and shake gently to dissolve all biquinoline.

d) pour into bottle and add another 250 ml. iso-amyl alcohol.

3) Acetate-citrate buffer (Copper):

1) 100 gm diabasic ammonium citrate

2) 100 gm sodium acetate

3) 50 gm hydroxylamine hydrochloride

4) 20 mls acetic acid

5) Dilute to make 1 litre (1000 ml)

4) Dithizone in Toluene (Zinc):

Make a concentration of 10 milligrams/litre by diluting 1000 mgms/litre solution in toluene.

5) Zinc Buffer:

1) 250 gms sodium acetate

2) 30 ml acetic acid

3) Dilute to 1 litre

4) Should not react with dithizone. If it does, purify by shaking with dithizone.

6) Thiosulfate solution:

1) 500 gms sodium thiosulfate in 1 litre water.

2) Dilute 10 times for use.

3) Should not react with dithizone.

7) Chloroformic Dithizone (Lead):

1) 10 milligrams dithizone per litre chloroform made by diluting concentrated solution.

8) Potassium Cyanide (Lead):

1) 10 grams in 100 mls water

2) Purify with dithizone

3) Must be prepared daily

<u>CAUTION</u>: POISONOUS!! - Do not use mouth-pipette!

9) Ammonium citrate buffer (Lead):

1) 50 gms ammonium citrate in 100 mls water

2) Add 5 gms hydroxamine hydrochloride

3) Add ammonium to bring pH to 9.0 - 9.5

4) Purify with Dithizone

10) Dithizone (Stock solution):

1) Make a 1000 mgm/litre chloroform solution (1 mgm/ml) ie. .250 gm in 250 ml chloroform.

<u>STORAGE OF STANDARDS</u>:

A) Copper:

1) Dissolve 0.250 gm Cu in 10 - 15 ml nitric acid. Heat gently if Cu does not readily dissolve.

2) Dilute to 250 ml with water and nitric acid to make 10% acidity.

B) Zinc:

Same as for copper except hydrochloric acid is used instead of nitric.

C) Lead:

Same as copper.

This gives a standard of 1000 gammas/ml. These solutions will keep indefinitely. For daily use, we dilute 10 ml to 100 ml giving solutions of 100 gammas/ml. These keep for 3 or 4 weeks.

Revised Sheet, Jan. 1965.

LEAD
IN SOIL AND PLANT ASH

REAGENTS:

DITHIZONE: 10 milligrams per litre in chloroform (only chloroform will do) diluting 1.0 mg. per ml. solution.

AMMONIUM CITRATE: 50 gms. in 100 mls. water, plus 5 gms. hydroxylamine hydrochloride: add ammonia to bring the pH to 8.5 - 9.0 (verify before using). Check for lead with dithizone in the presence of cyanide or purify by shaking with chloroformic dithizone until a mixed color persists.

POTASSIUM CYANIDE: 10 gms. in 100 mls. of water. Test for purity as for citrate solution. Eventually purify with Dz removing dithizone after with pure chloroform. POISONOUS! Does not keep. Check each time before using, on a blank containing 100 zinc.

ASCORBIC ACID: Test for absence of lead. Weigh 10 mgms. into a small tube and keep to see how much to add.

Normally these reagents are pure enough for our purposes, with the possible exception of citrate. Generally a good blank is a sufficient test for purity.

LEAD STANDARD: 100 gammas per ml. in 1/10N Nitric, diluted to 1 γ/ml.

SOIL: Digest, pass decanted or filtered solution, all or aliquot into a shaking cylinder.

PLANT ASH OR PEATY SOIL ASH: Evaporate to dryness with 1/2 - 2 mls. 3N HCl: Take up with 1-2 drops 3N HCl and 2-3 water. Transfer into a shaking cylinder.

PROCEDURE: To unknown, add 5-10 mgms. ascorbic acid, wait a few minutes, then add 1 ml. citrate solution (or 1 ml. citrate per 5 mls. sample solution for large volumes) and eventually enough conc. ammonia to make the pH . ·9,0. No ammonia is necessary for ash samples or low acidity standards. Add 1/2 ml. cyanide solution (dipping a large diameter pipette - NEVER USING MOUTH TO PIPETTE).

Make a set of standards:

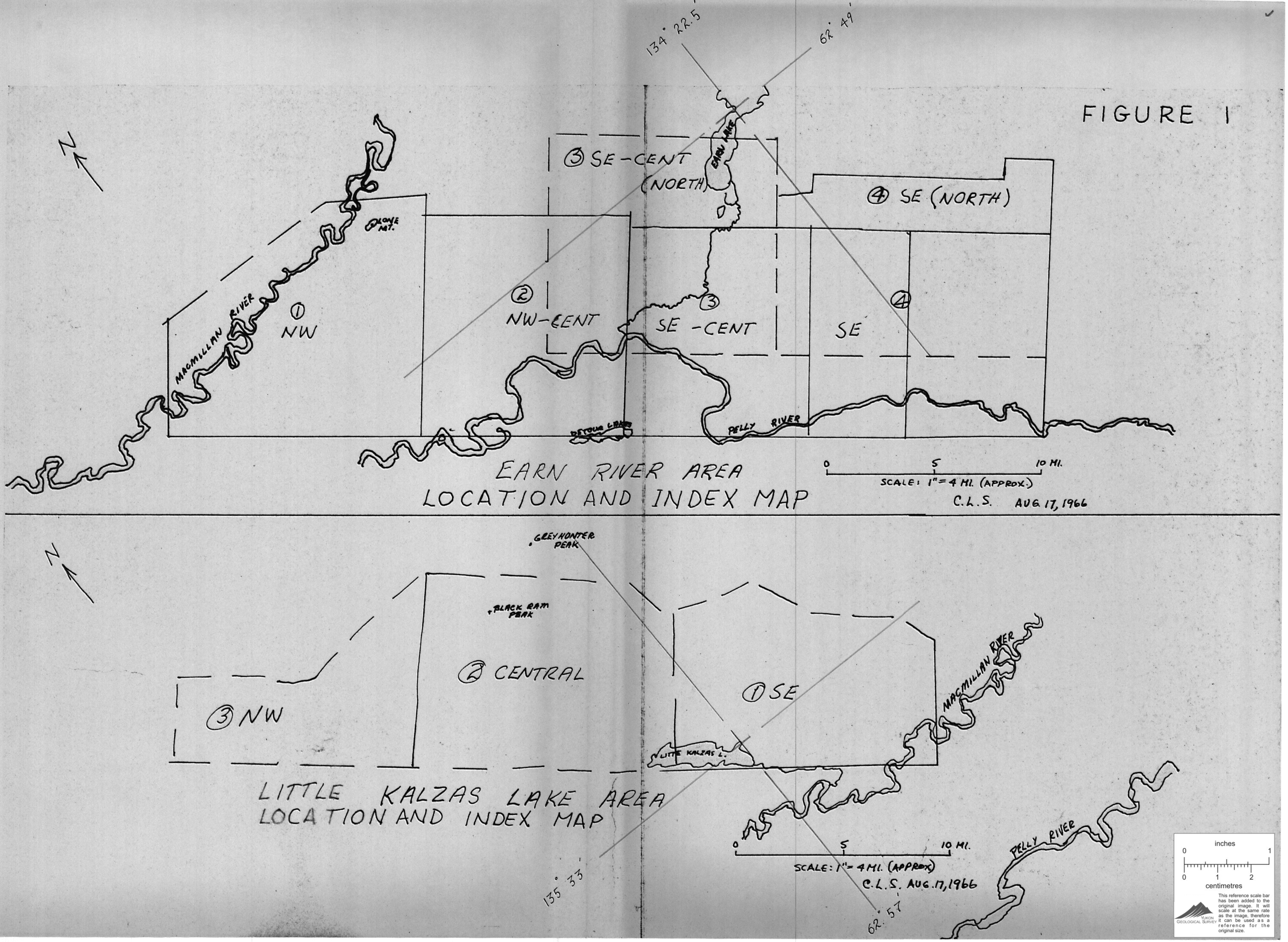
γ lead	0.2 γ	0.5 γ	0.8 γ	1.0 γ	1.5 γ	2.0 γ	3.0 γ	4.0 γ	5.0 γ	8.0 γ
Mls. of Dz.	1/2 ml.	1/2 ml.	1/ml.	1/ ml.	2/ ml.	2/ml.	3/ ml.	3/ ml.	3/ ml.	4/ ml.

or whatever will be convenient for the amounts involved. Repetition of Dz/Pb Ratios take care of small amounts of lead in reagents.

With a burette or pipette add 1/2 ml. dithizone solution. When using a pipette, blow into it first so that the air breathed in is not chloroform-rich air. Shake and compare with lower standards unless the color is pink. In such case, add more dithizone until a mixed color persists and matches a standard. If the sample appears extremely rich, take a smaller aliquot and then iron is often sufficiently diluted to enable titration to proceed at once.

For higher amounts than 8 γ add dithizone and shake until color for 8 γ is reached, then there are 2 γ per ml. used.
At most 200 can be dissolved in 30 ml. of N. sulfuric. Rich samples should be done again with 0.2 gms. instead of 2 gms.

FIGURE 1



134° 22.5'
62° 49'
N
① NW
MACMILLAN RIVER
ONE MT.
② NW-CENT
③ SE-CENT (NORTH)
EARN LAKE
③ SE-CENT
④ SE (NORTH)
④ SE
PELLY RIVER
DETOUR LAKE
EARN RIVER AREA
LOCATION AND INDEX MAP
0 5 10 MI.
SCALE: 1" = 4 MI. (APPROX.)
C.L.S. AUG. 17, 1966
N
GREYHUNTER PEAK
BLACK RAM PEAK
③ NW
② CENTRAL
① SE
LITTLE KALZAS L.
MACMILLAN RIVER
PELLY RIVER
LITTLE KALZAS LAKE AREA
LOCATION AND INDEX MAP
0 5 10 MI.
SCALE: 1" = 4 MI. (APPROX.)
C.L.S. AUG. 17, 1966
135° 33'
62° 57'


FIGURE 2
Air Magnetics Map
of Central (L.) & S.E. (R.)
Little Kalzas Lake
Area
(Area #1)
scale: 1" = 2000'
contour interval: 50γ & 100γ
NOTE - 100γ COLOUR INTERVAL
Ram Claim Group
Little
Kalzas
Lake
62° 57'
135° 33.5'

FIGURE 3
Air Magnetics Map
of N.W. Little
Kalzas Lake Area
(Area #1)
scale: 1" = 2000'
Contour Interval: 100 γ


FIGURE 4
AIR MAG MAP
N.W EARN R. AREA (AREA 3)
SCALE : 1" = 2000'
MAG CONTOUR INTERVAL : 50γ
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY
MAC GROUP
MACMILLAN RIVER
62°52.4'
135°07.7'
100
150
200
250
300

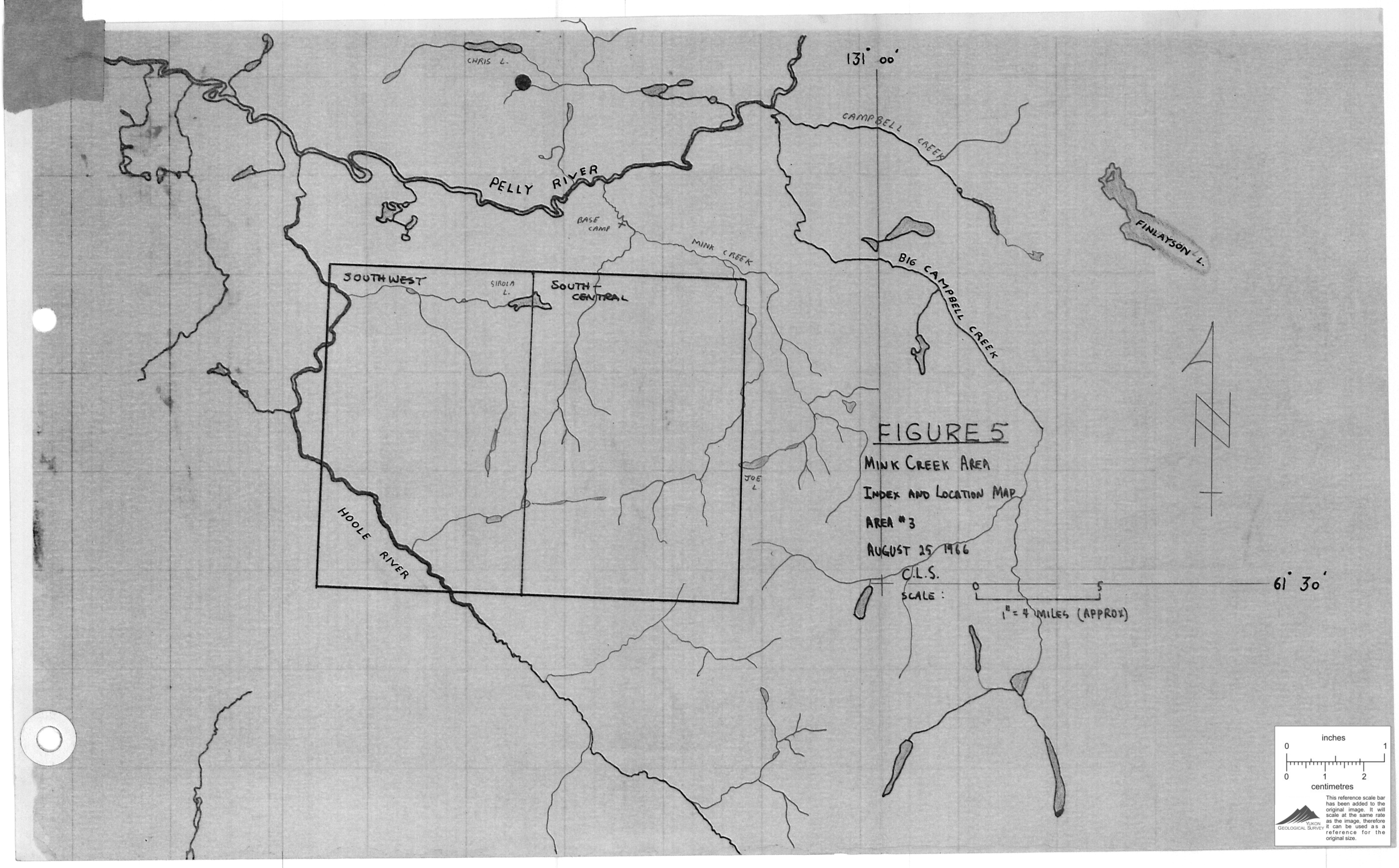

CHRIS L.
131° 00'
CAMPBELL CREEK
PELLY RIVER
BASE CAMP
MINK CREEK
FINLAYSON L.
BIG CAMPBELL CREEK
SOUTHWEST
SIROLA L.
SOUTH-CENTRAL
JOE L.
HOOLE RIVER
FIGURE 5
MINK CREEK AREA
INDEX AND LOCATION MAP
AREA #3
AUGUST 25 1966
C.L.S.
SCALE : 0 5
1" = 4 MILES (APPROX)
61° 30'

FIGURE 6


Air Magnetics Map
MAR, CHER & NAN CLAIM GROUP
SCALE: 1" = 2000'
Aug 24, 1966 CLS.
DRAFTED BY: JOE SIEFKE ESQ.
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY
N
HOOLE RIVER
131° 40'
61° 36'
NAN
MAR
CHER
RED

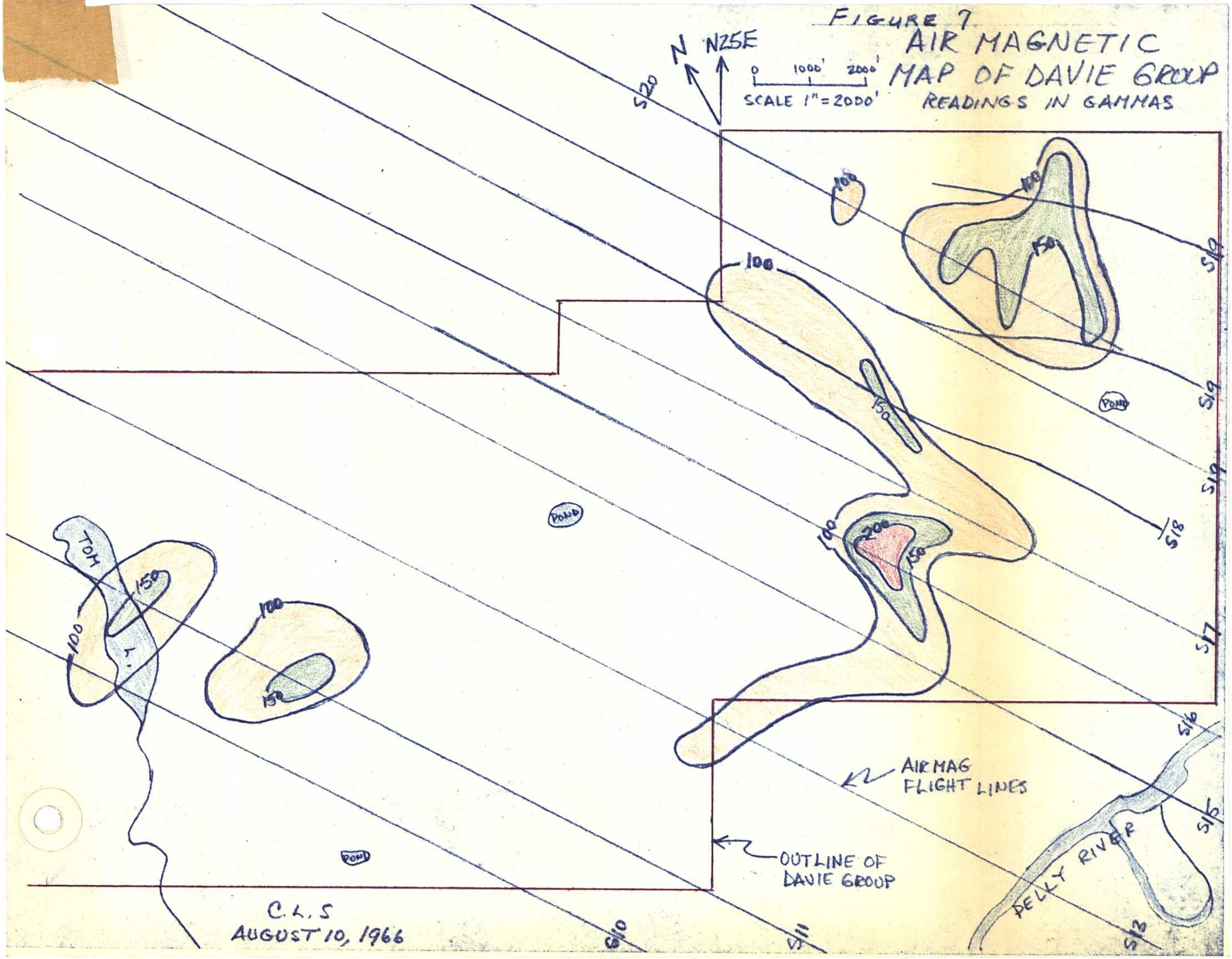


FIGURE 7
AIR MAGNETIC
MAP OF DAVIE GROUP
READINGS IN GAMMAS
N
N25E
0 1000' 2000'
SCALE 1" = 2000'
S/20
S/19
S/19
S/19
S/18
S/17
S/16
S/15
S/13
S/11
S/10
100
150
200
POND
POND
POND
TOM
L.
AIRMAG
FLIGHT LINES
OUTLINE OF
DAVIE GROUP
PELLY RIVER
C.L.S
AUGUST 10, 1966

FIGURE 8

RAM CLAIM GROUP LOCATION MAP

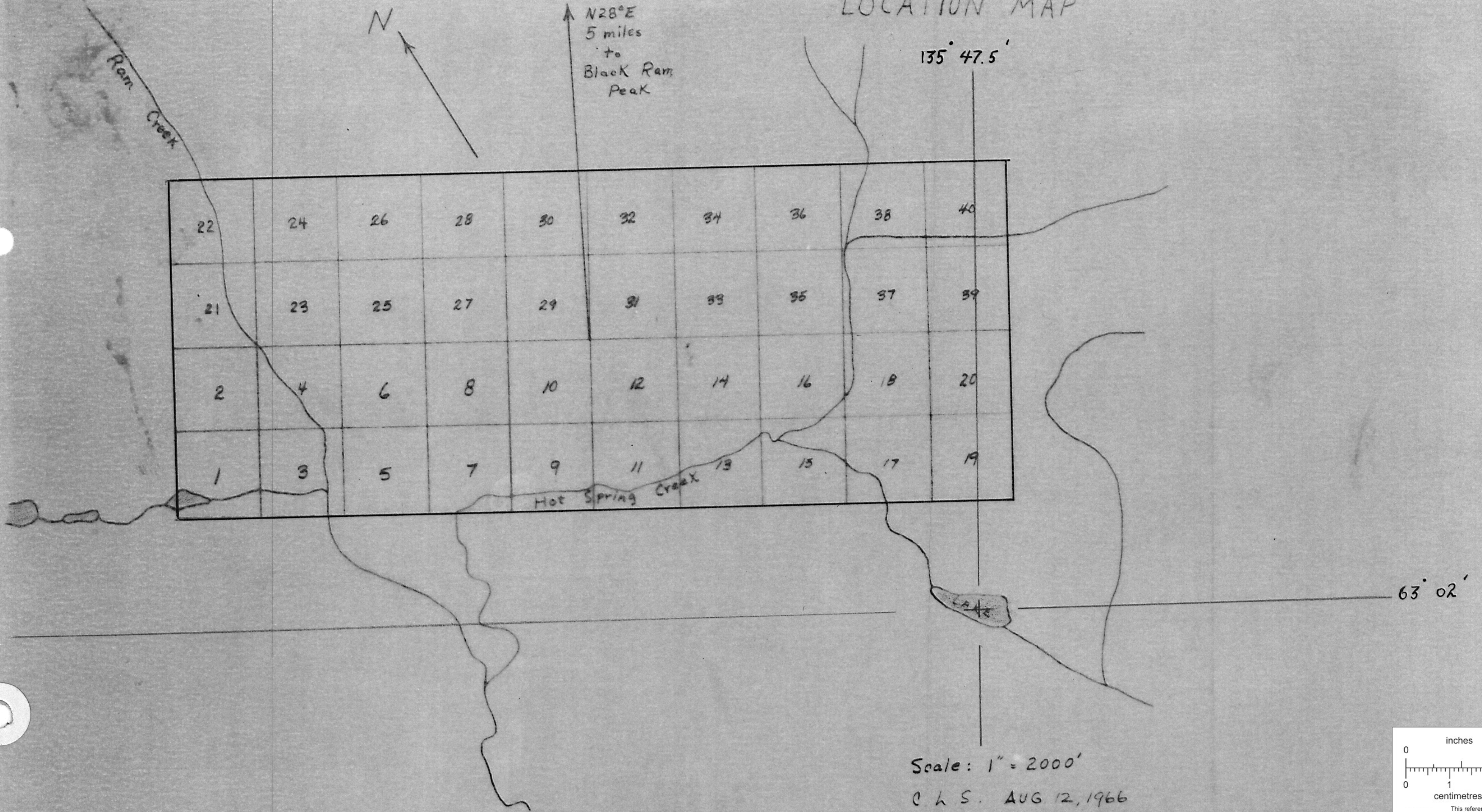


FIGURE 9

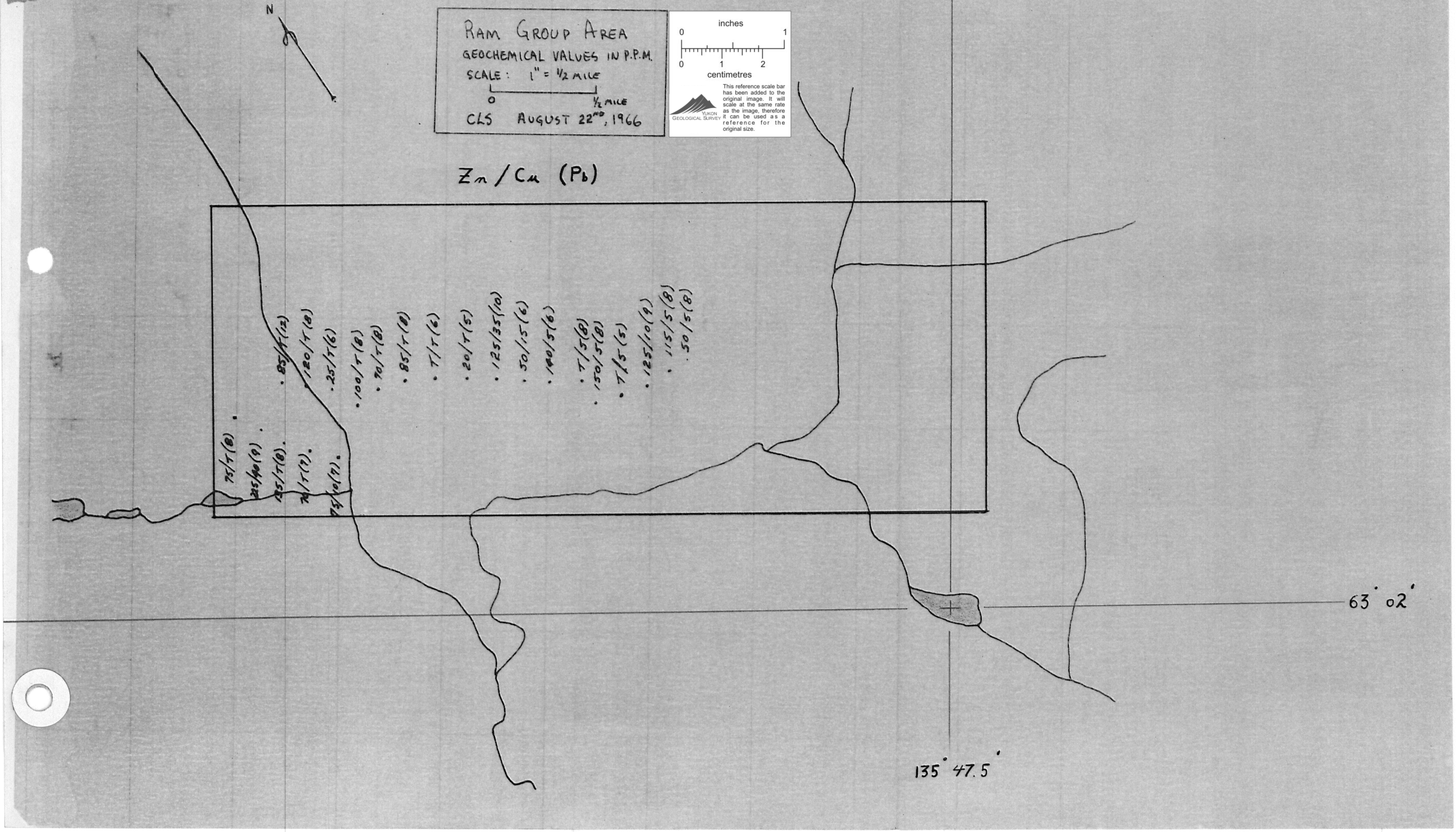
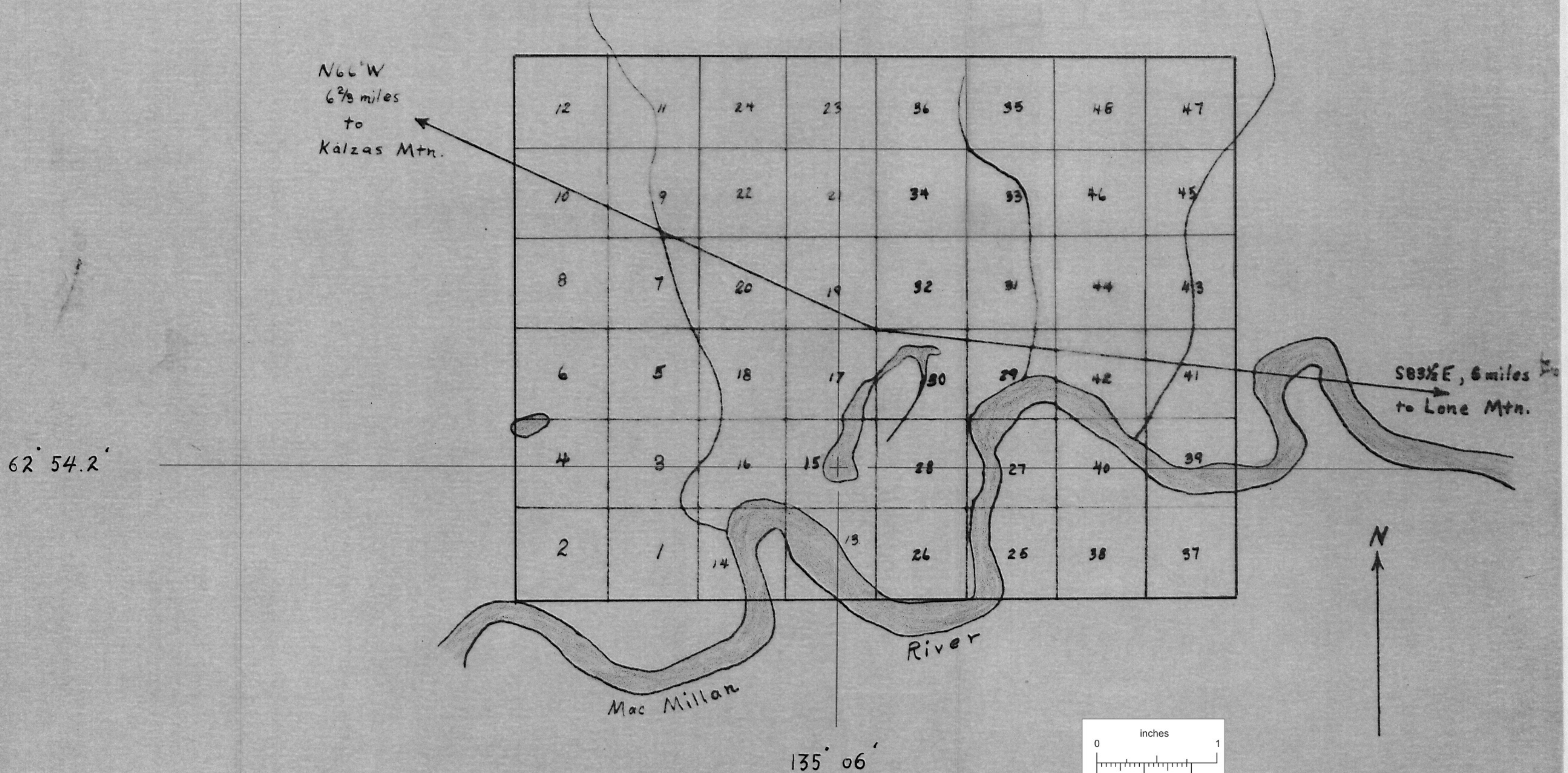

N
RAM GROUP AREA
GEOCHEMICAL VALUES IN P.P.M.
SCALE : 1" = 1/2 MILE
0
1/2 MILE
CLS AUGUST 22ND, 1966
inches
0
1
0
1
2
centimetres
YUKON GEOLOGICAL SURVEY
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
Zn / Cu (Pb)
75/T(8)
225/40(9)
135/T(8)
70/T(7)
75/10(7)
85/T(12)
120/T(8)
25/T(6)
100/T(8)
70/T(8)
85/T(8)
T/T(6)
20/T(5)
125/35(10)
50/15(6)
140/5(6)
T/5(8)
150/5(8)
T/5(5)
125/10(9)
115/5(8)
50/5(8)
63° 02'
135° 47.5'

FIGURE 10
MAC CLAIM GROUP
LOCATION MAP



inches
0 1
0 1 2
centimetres

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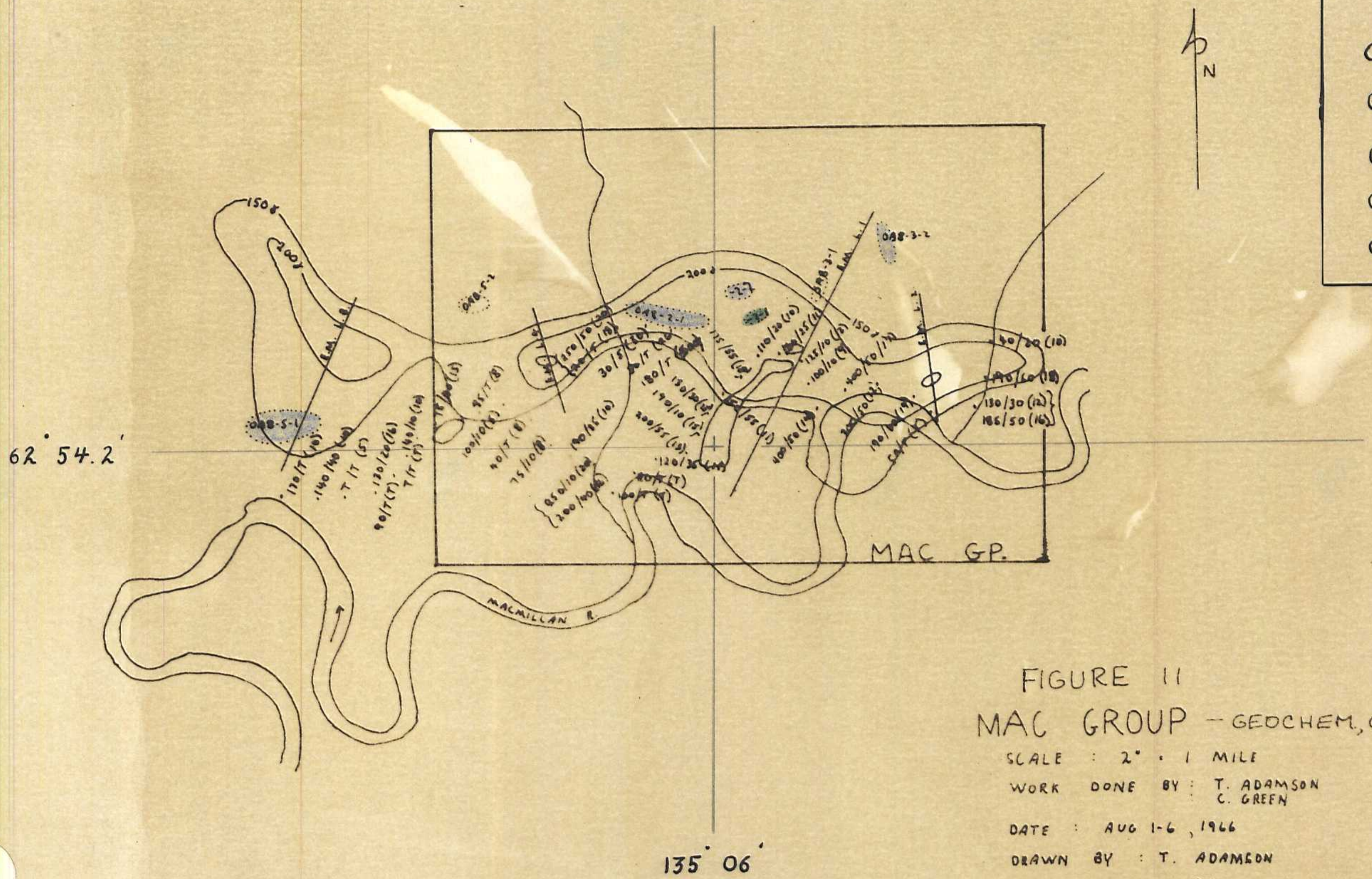
YUKON GEOLOGICAL SURVEY

Scale: 1" = 2000'
C.L.S. AUG.12,1966



LEGEND

OA8-2-2 – SCHISTOSE VOL.

OA8-3-1 – " FELSITE

OA8-3-2 – GREY VOLCANIC

OA8-5-2 – LIMY SCH. VOLCANIC

OA8-5-1 – GABBRO

FIGURE 11

MAC GROUP – GEOCHEM, GEOL.

SCALE : 2" = 1 MILE

WORK DONE BY : T. ADAMSON
C. GREEN

DATE : AUG 1-6, 1966

DRAWN BY : T. ADAMSON

DATE : AUG. 11, 1966

FIGURE 12

MAC GROUP - E.M. LINES

SCALE : 1" = 1/4 MILE

DRAWN BY : T. ADAMSON

DATE : AUG. 11 / 1966

inches 0 1

0 1 2 centimetres

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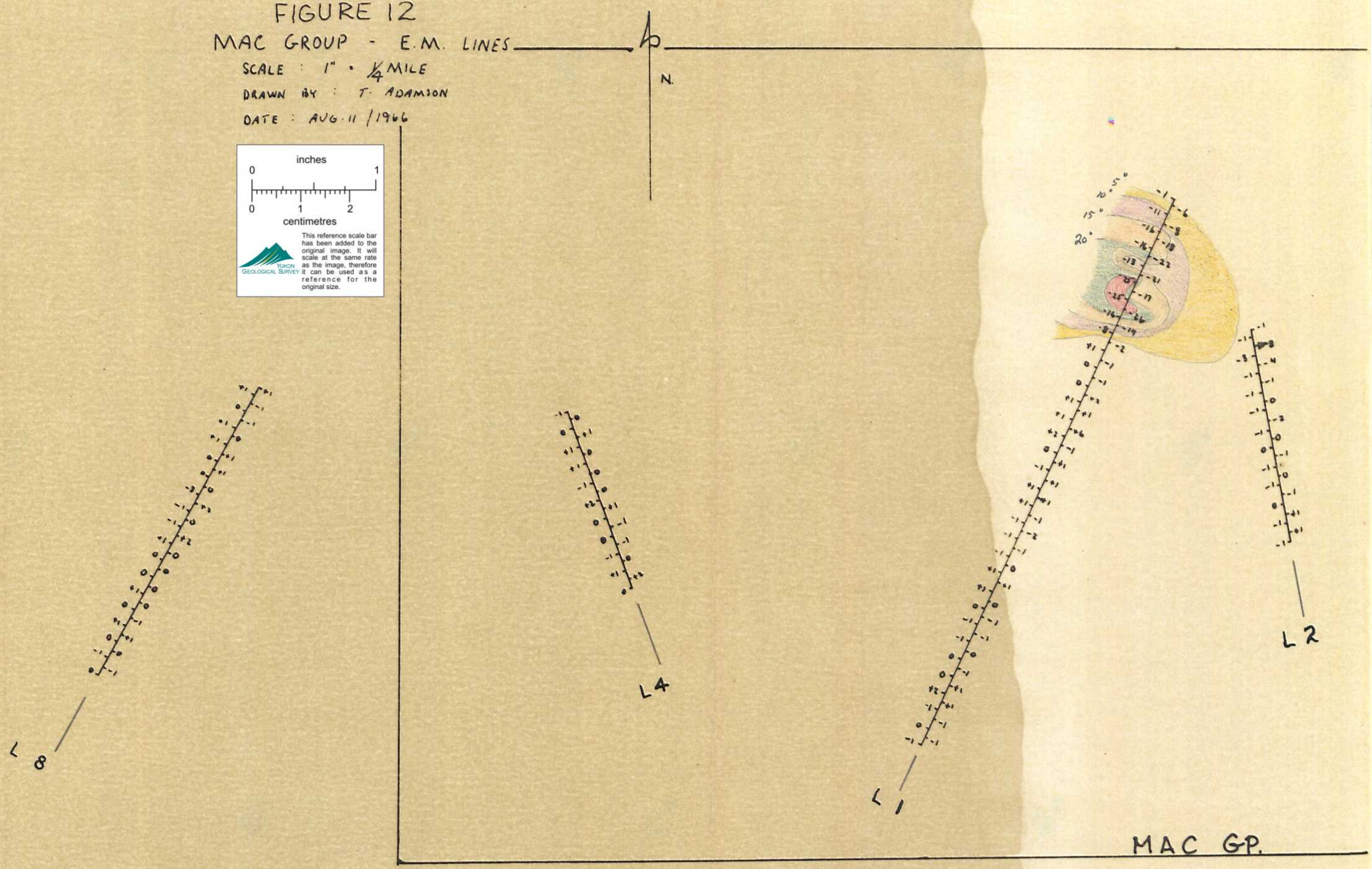
YUKON GEOLOGICAL SURVEY



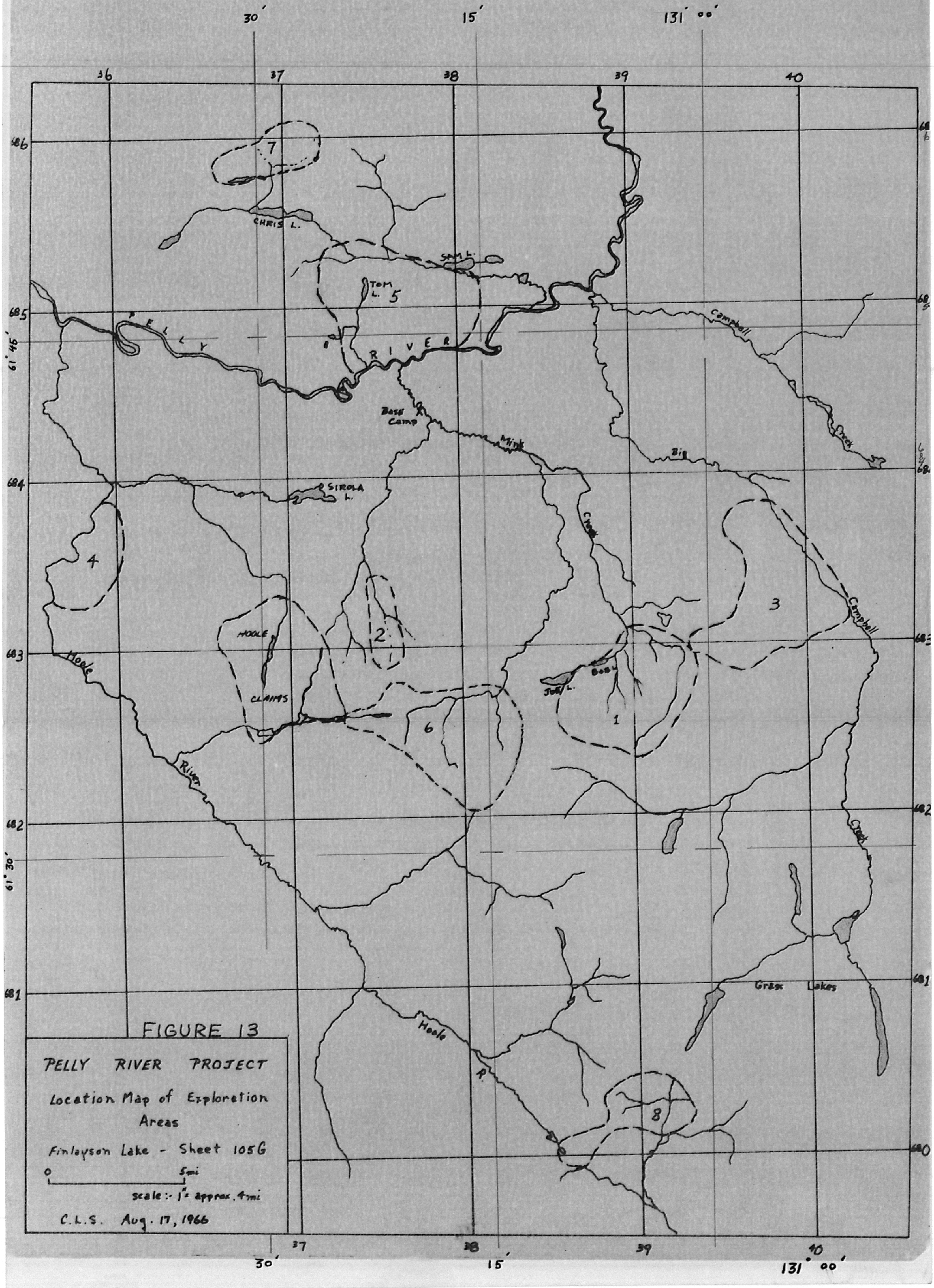


FIGURE 13

PELLY RIVER PROJECT

Location Map of Exploration Areas

Finlayson Lake - Sheet 105G

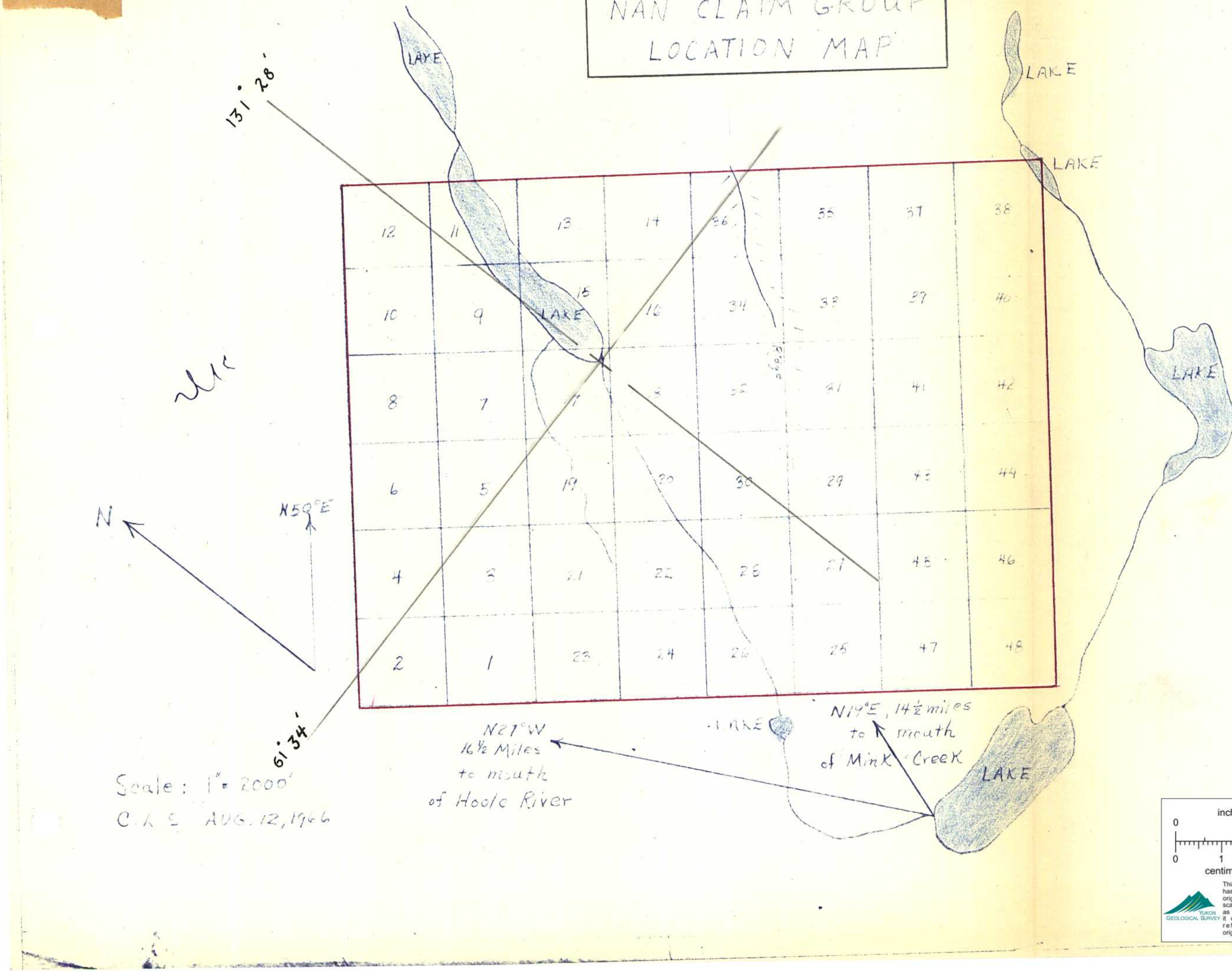
0 5mi

scale :- 1" approx. 4 mi

C.L.S. Aug. 17, 1966

GEOLOGIC MAP
MINK CR. AREA
SCALE 1" = 4 MI.
CLS AUG. 26, '66
N
FIGURE 14
AND — ANDESITE
BAS — BASALT(IC)
CARB — CARBONACEOUS
GRA — GRAPHITIC
GNS — GREENSTONE
GWKE — GREYWACKE
PROP — PROPLITIZED
QTZ — QUARTZ
RHY — RHYOLITE
SCH — SCHIST (OSE)
SER — SERICITE
VOL — VOLCANICS
6a BASALTS
A3 SCHISTOSE FELSITES & FELDSPAR PORPHYRY FLOWS, INTERBEDDED LIMESTONES
A2 PROPYLITIZED ANDESITES (CHL.-CARB. SCHISTS), SCHISTOSE FELSITES, SOME UNITS MAGNETIC, LIMESTONE LENSES
A1 QUARTZ SERICITE SCHISTS (SCHISTOSE SILICIC VOLCANICS), WITH INTERBEDDED GRAPHITIC SCHISTS. NORTH OF PELLY R.: A1U - SERICITE-RICH SCHISTS, VERY PURE GRAPHITE SCHISTS; A1M - QUARTZ SERICITE SCHIST. A1L - QUARTZ SERICITE BIOTITE SCHIST.
C AUGEN GNEISS, FOLIATED GRANITE (PRE-METAMORPHIC BASEMENT)
INTRUSIVES: 9 GRANITE, GRANODIORITE, QUARTZ DIORITE
D PERIDOTITE, SERPENTINE
PELLY RIVER
OGDEN FAULT
DUNSMORE FAULT
TINTINA FAULT
Mink Creek
Big Campbell Cr.
Hoole River
Gass Lakes
BASE CAMP
SIROLA L.
JOEL L.
BOBL.
CHRIS L.
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

FIGURE 15
NAN CLAIM GROUP LOCATION MAP



Scale: 1" = 2000'
C.L.S. AUG. 12, 1966

FIGURE 16
MAR CLAIM GROUP
LOCATION MAP

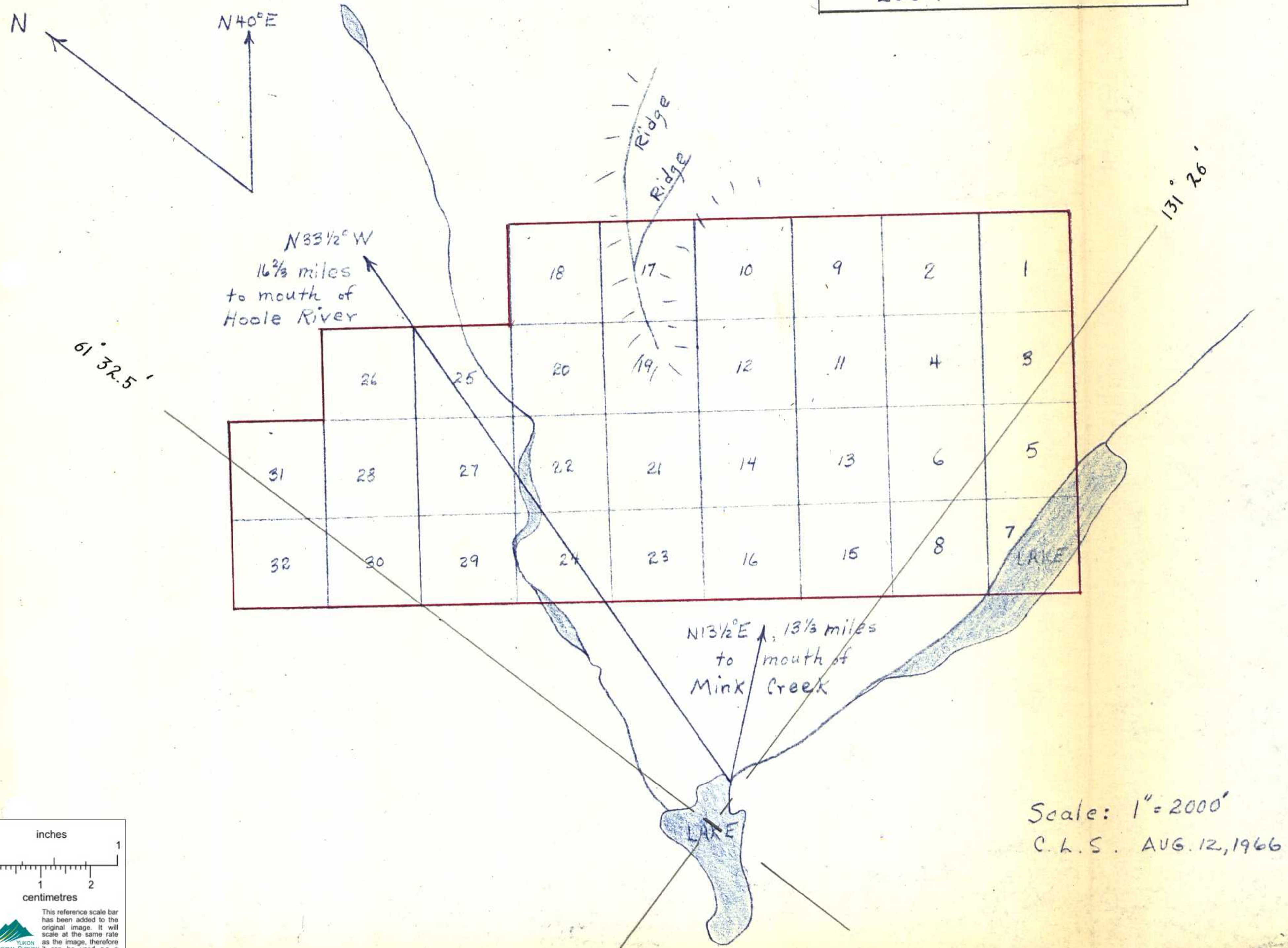
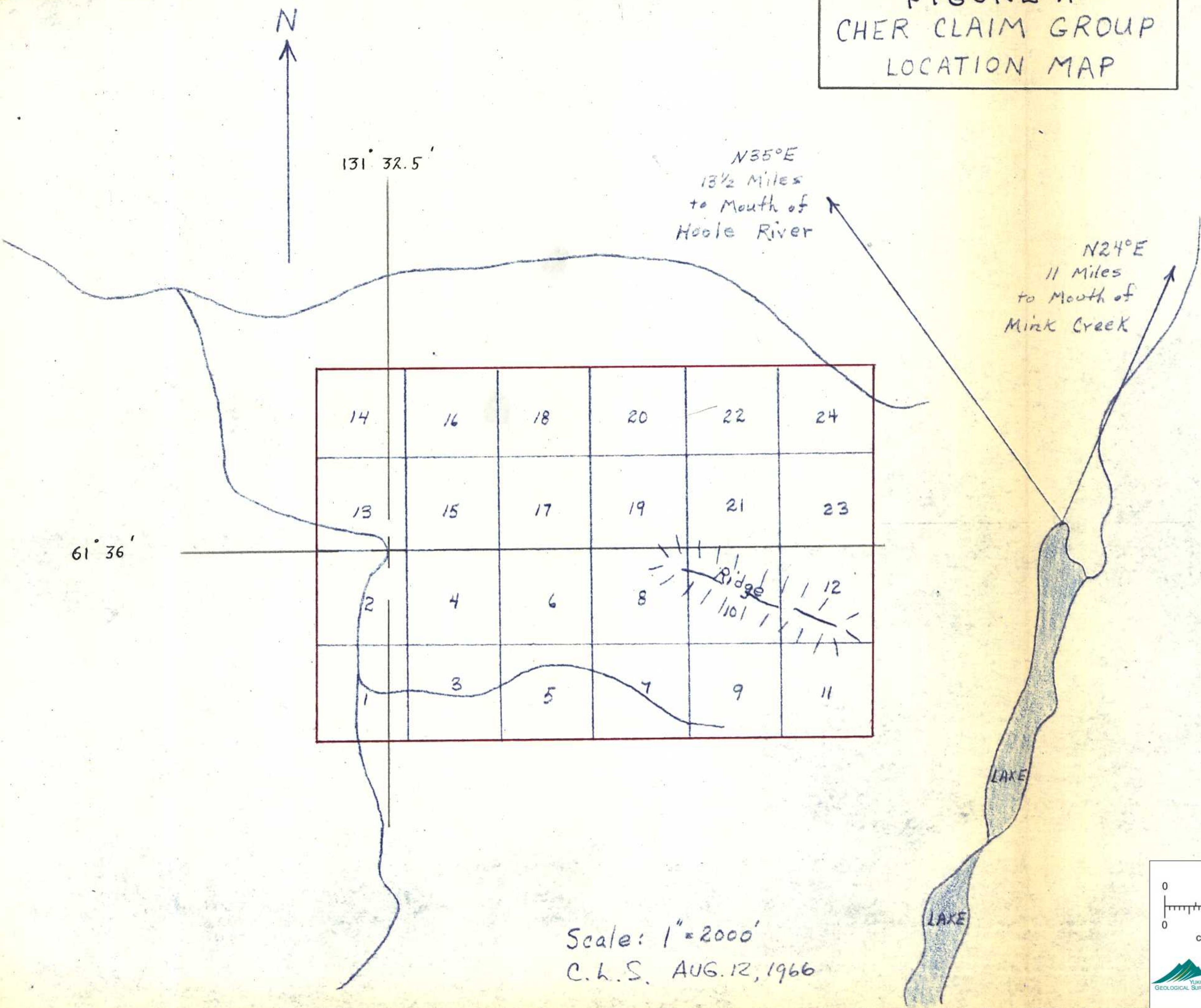


FIGURE 17
CHER CLAIM GROUP
LOCATION MAP



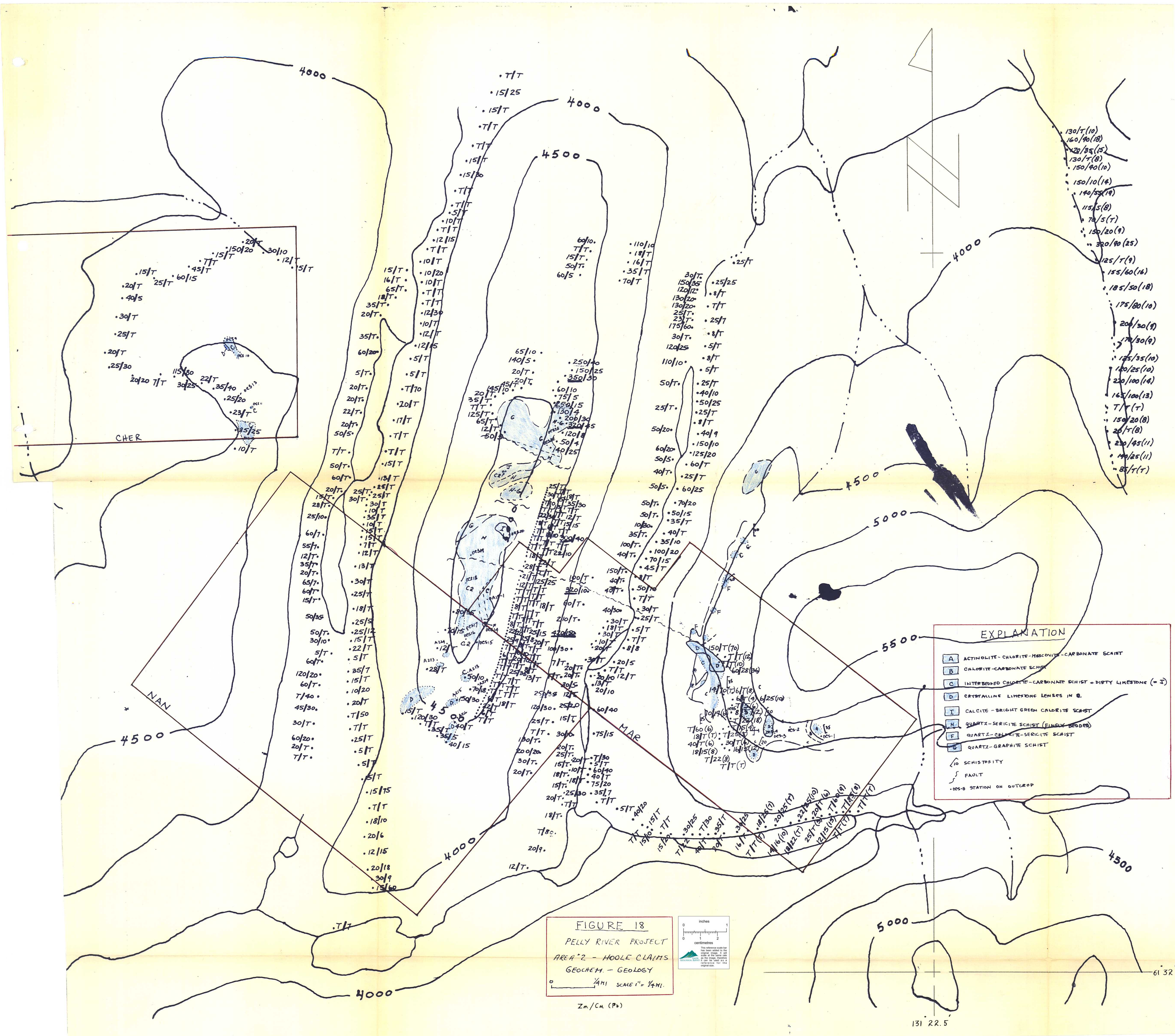


FIGURE 18
PELLY RIVER PROJECT
AREA #2 - HOOLE CLAIMS
GEOCHEM. - GEOLOGY
0 1/4 MI SCALE 1" = 1/4 MI.
Zn/Cu (Pb)
EXPLANATION
A ACTINOLITE-CHLORITE-MUSCOVITE-CARBONATE SCHIST
B CHLORITE-CARBONATE SCHIST
C INTERBEDDED CHLORITE-CARBONATE SCHIST + DIRTY LIMESTONE (= I)
D CRYSTALLINE LIMESTONE LENSES IN B.
I CALCITE - BRIGHT GREEN CHLORITE SCHIST
H QUARTZ-SERICITE SCHIST (FINELY BEDDED)
F QUARTZ-CHLORITE-SERICITE SCHIST
G QUARTZ-GRAPHITE SCHIST
10 SCHISTOSITY
FAULT
• OCS-3 STATION ON OUTCROP
CHER
NAN
MAR
4000
4500
5000
5500
61 32'
131 22.5'
inches
0 1
0 1 2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

FIGURE 19
NAN, MAR, (AND RED) GROUPS
(HOOLE CLAIMS)
E. M. SURVEY
0 750' 1500'
SCALE 1" = 750'
CLS AUG. 25, 1966
N
N MAG
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY
RED
MAR
NAN
23
20°
10°

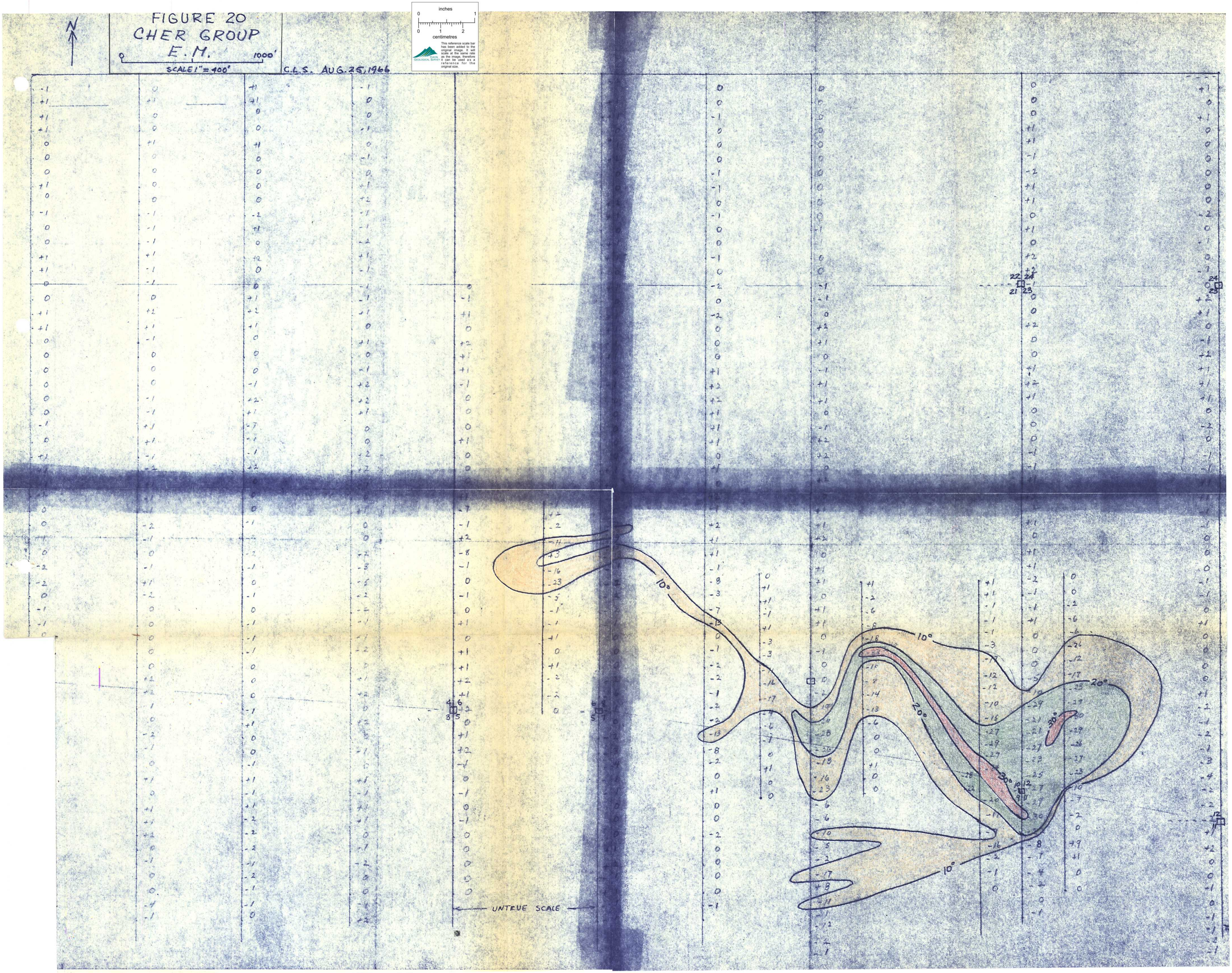


FIGURE 20
CHER GROUP
E.M.
0
1000'
SCALE 1" = 400'
C.L.S. AUG. 25, 1966
N
UNTRUE SCALE
10°
20°
30°

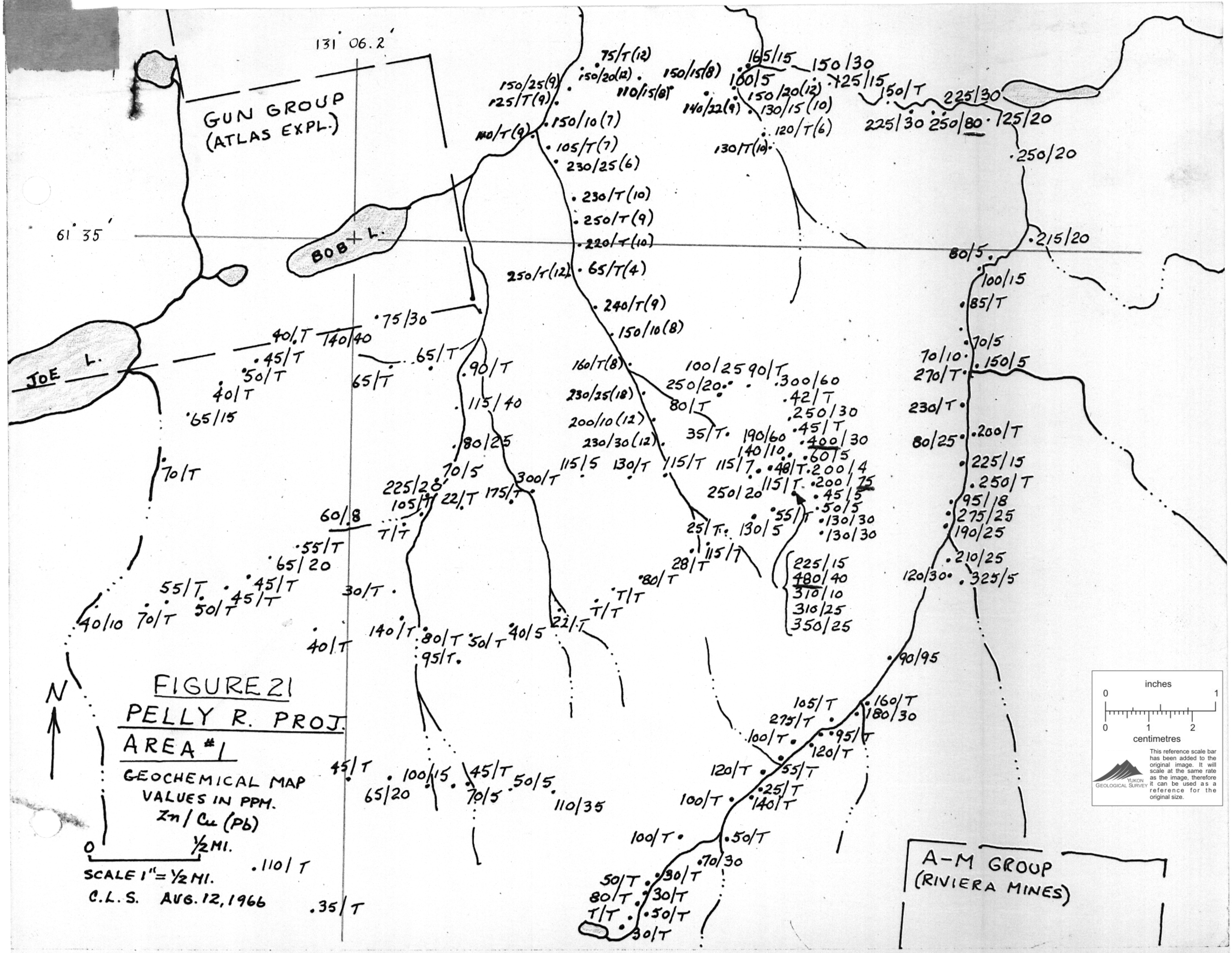
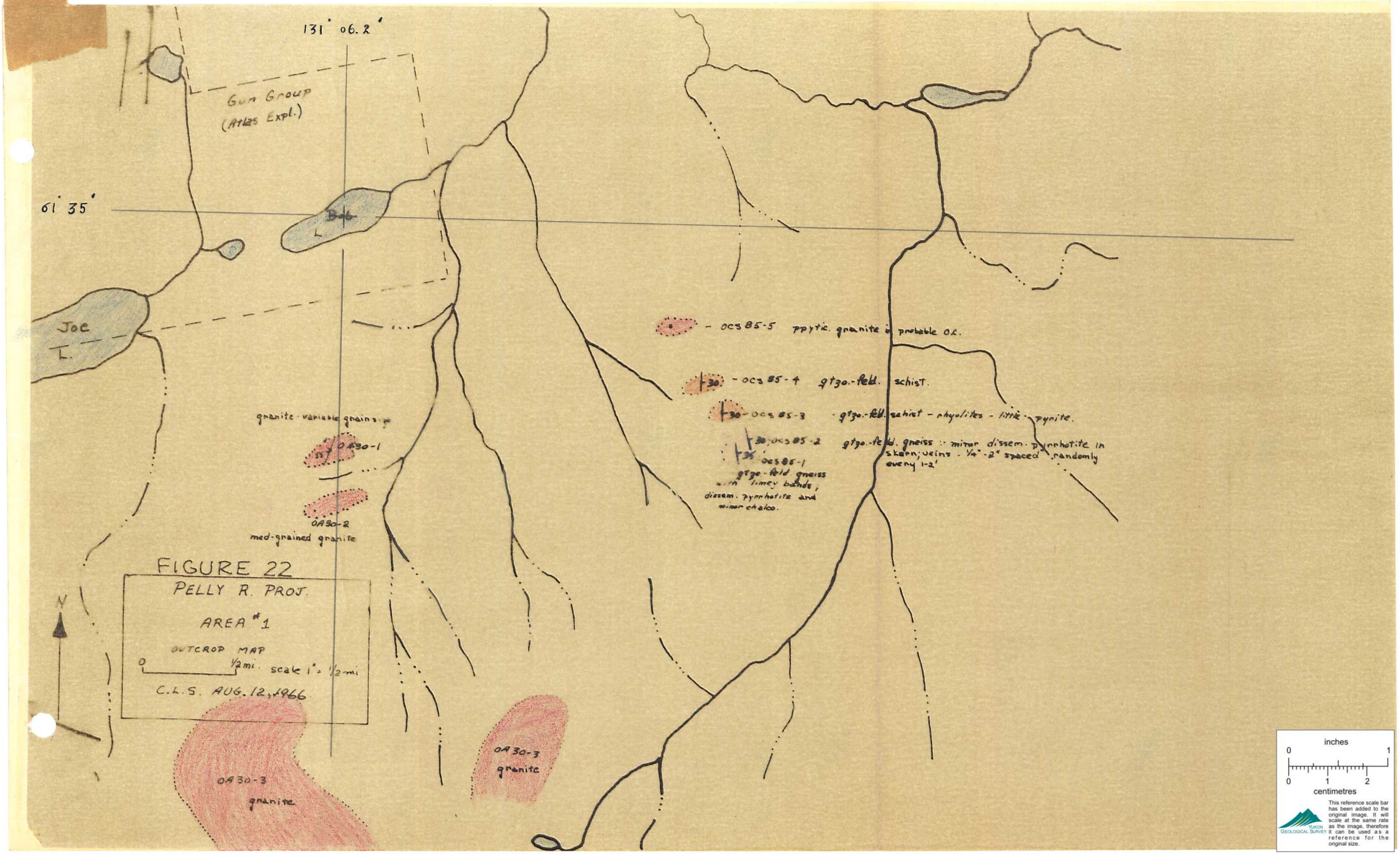


FIGURE 21
PELLY R. PROJ.
AREA #1
GEOCHEMICAL MAP
VALUES IN PPM.
Zn / Cu (Pb)


131° 06.2'
61° 35'
Gun Group
(Atlas Expl.)
B
L.
Joe
L.
- OCS 85-5 ppytic. granite probable O.C.
30 - OCS 85-4 qt30.-feld. schist.
30 - OCS 85-3 - qt30.-feld. schist - rhyolites - little - pyrite.
30; OCS 85-2 qt30.-feld. gneiss :: minor dissem. pyrrhotite in skarn; veins - 1/4" - 2" spaced randomly every 1-2'
35 OCS 85-1 qt30-feld. gneiss with limey bands; dissem. pyrrhotite and minor chalco.
granite - variable grains
OA30-1
OA30-2
med-grained granite
OA 30-3 granite
OA 30-3 granite
N
FIGURE 22
PELLY R. PROJ.
AREA #1
OUTCROP MAP
0 1/2 mi. scale 1" = 1/2 mi
C.L.S. AUG. 12, 1966
inches
0 1
0 1 2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

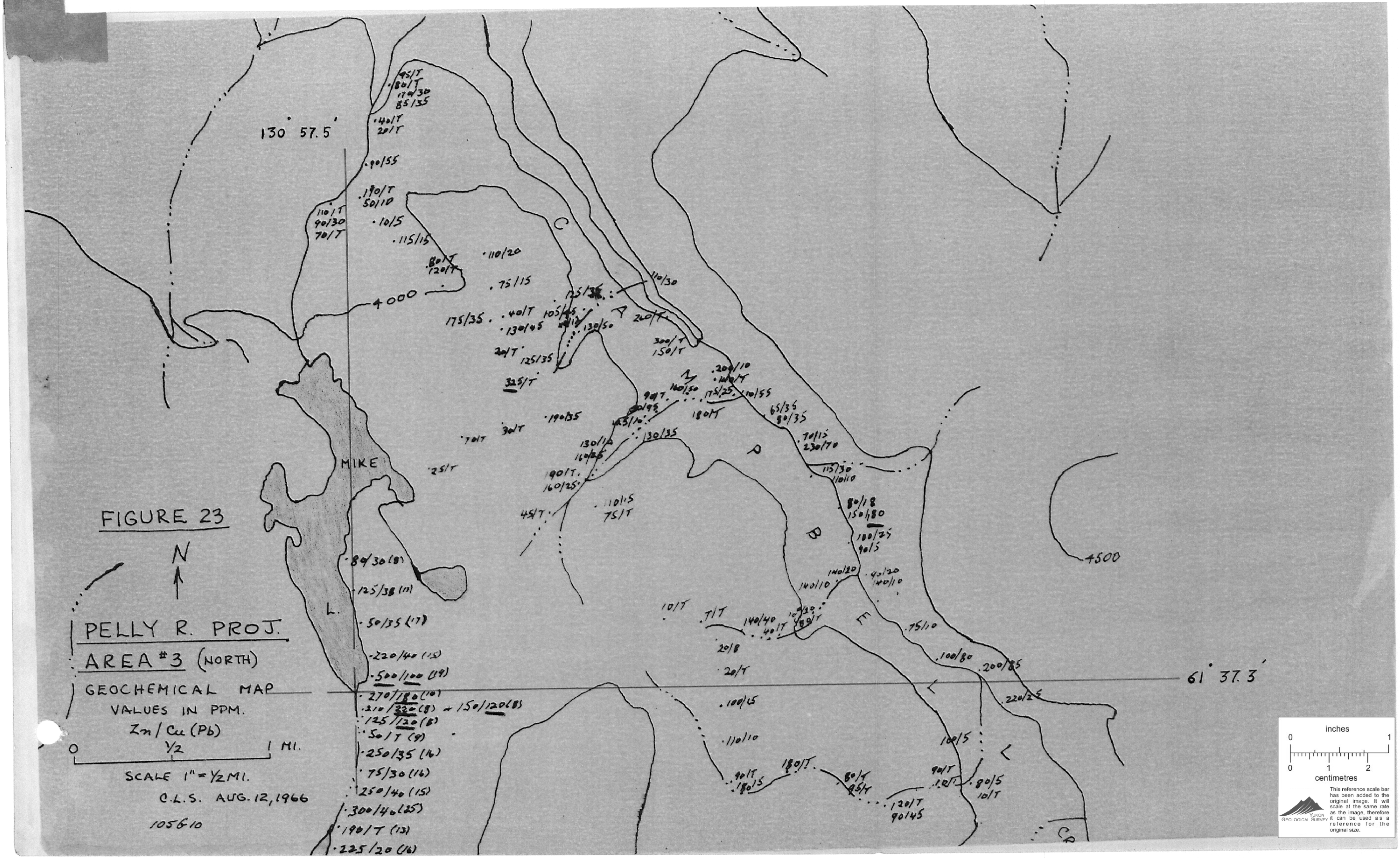
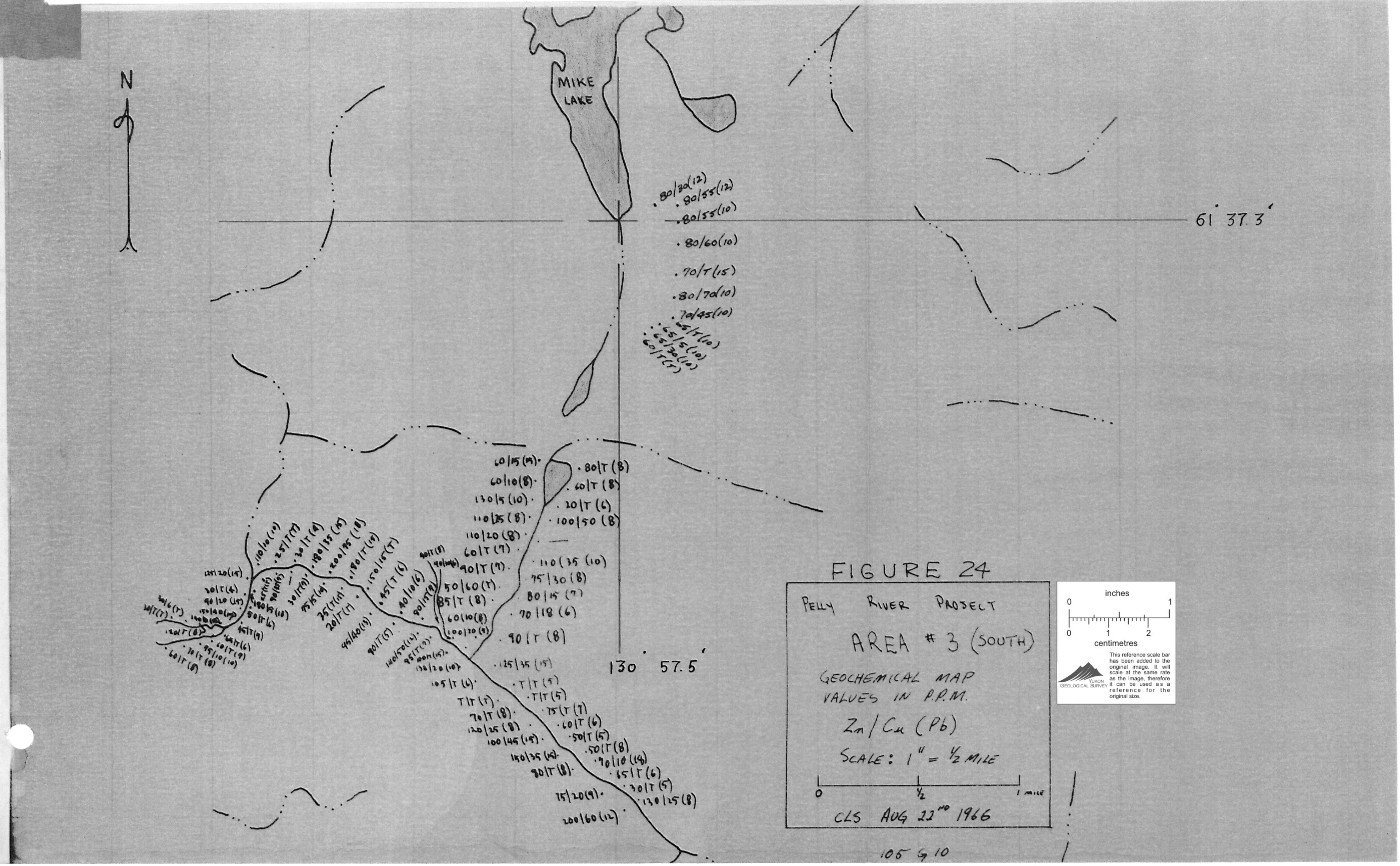
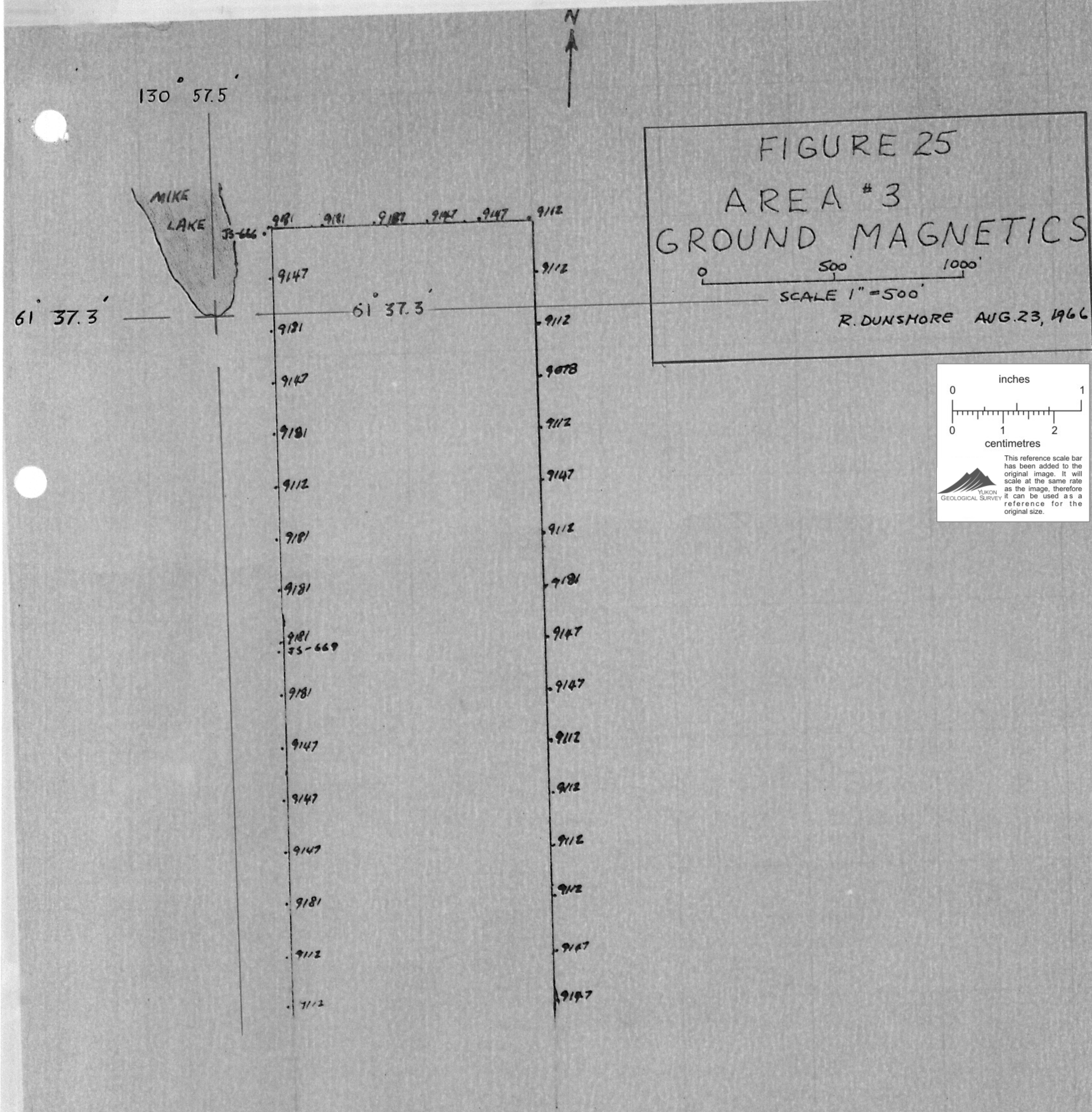
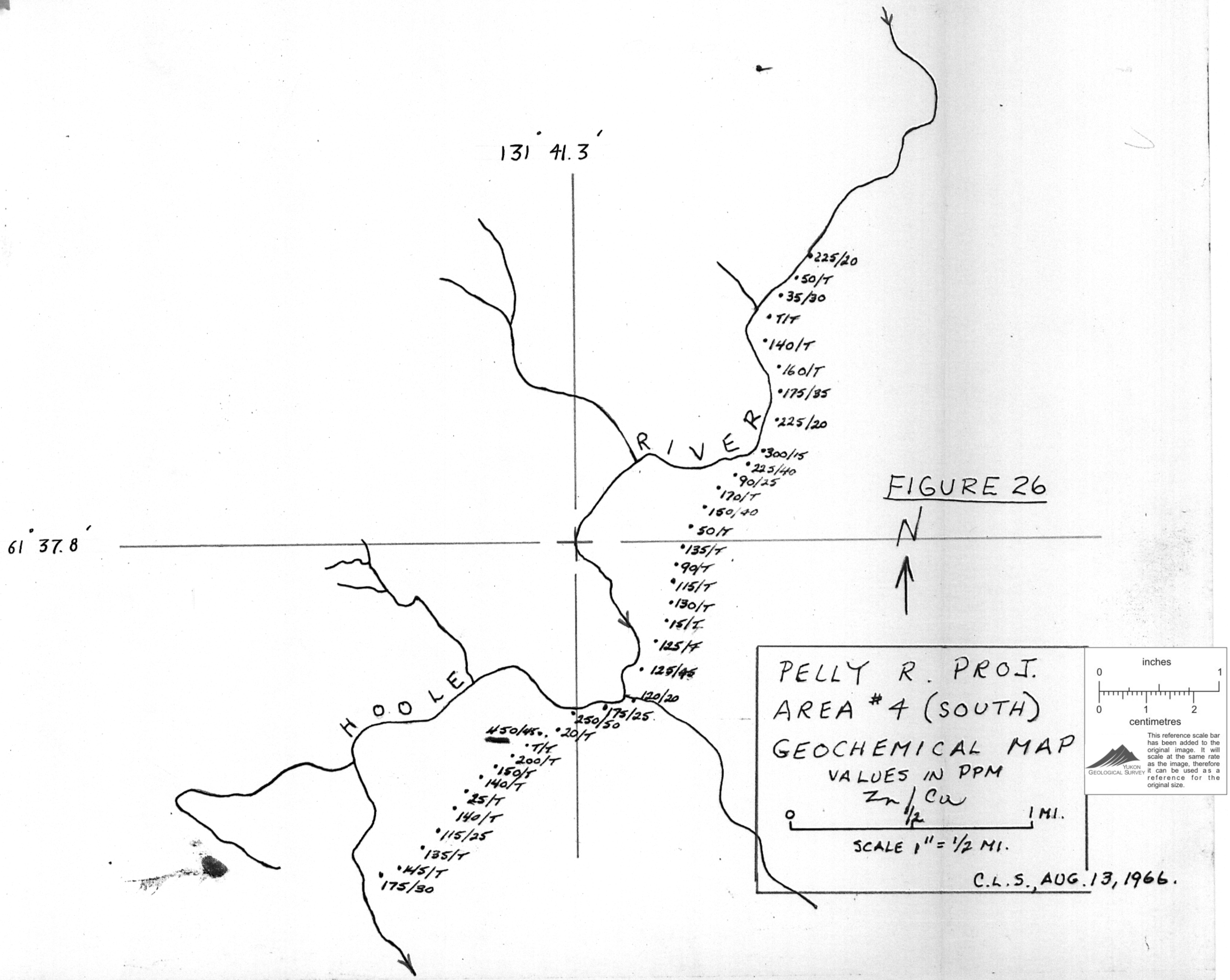


FIGURE 23
N
PELLY R. PROJ.
AREA #3 (NORTH)
GEOCHEMICAL MAP
VALUES IN PPM.
Zn / Cu (Pb)
0 1/2 1 MI.
SCALE 1" = 1/2 MI.
C.L.S. AUG. 12, 1966
105G10
130° 57.5'
61° 37.3'
MIKE
L.
C
A
M
P
B
E
L
L
4000
4500
80/30 (8)
125/38 (11)
50/35 (17)
220/40 (15)
500/100 (19)
270/180 (10)
210/320 (8)
150/120 (8)
125/120 (8)
50/T (9)
250/35 (16)
75/30 (16)
250/40 (15)
300/40 (25)
190/T (13)
225/20 (16)
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY


N
MIKE LAKE
61° 37.3'
130° 57.5'
FIGURE 24
PELLY RIVER PROJECT
AREA # 3 (SOUTH)
GEOCHEMICAL MAP
VALUES IN P.P.M.
Zn / Cu (Pb)
SCALE: 1" = 1/2 MILE
0
1/2
1 MILE
CLS AUG 22ND 1966
105 G 10
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

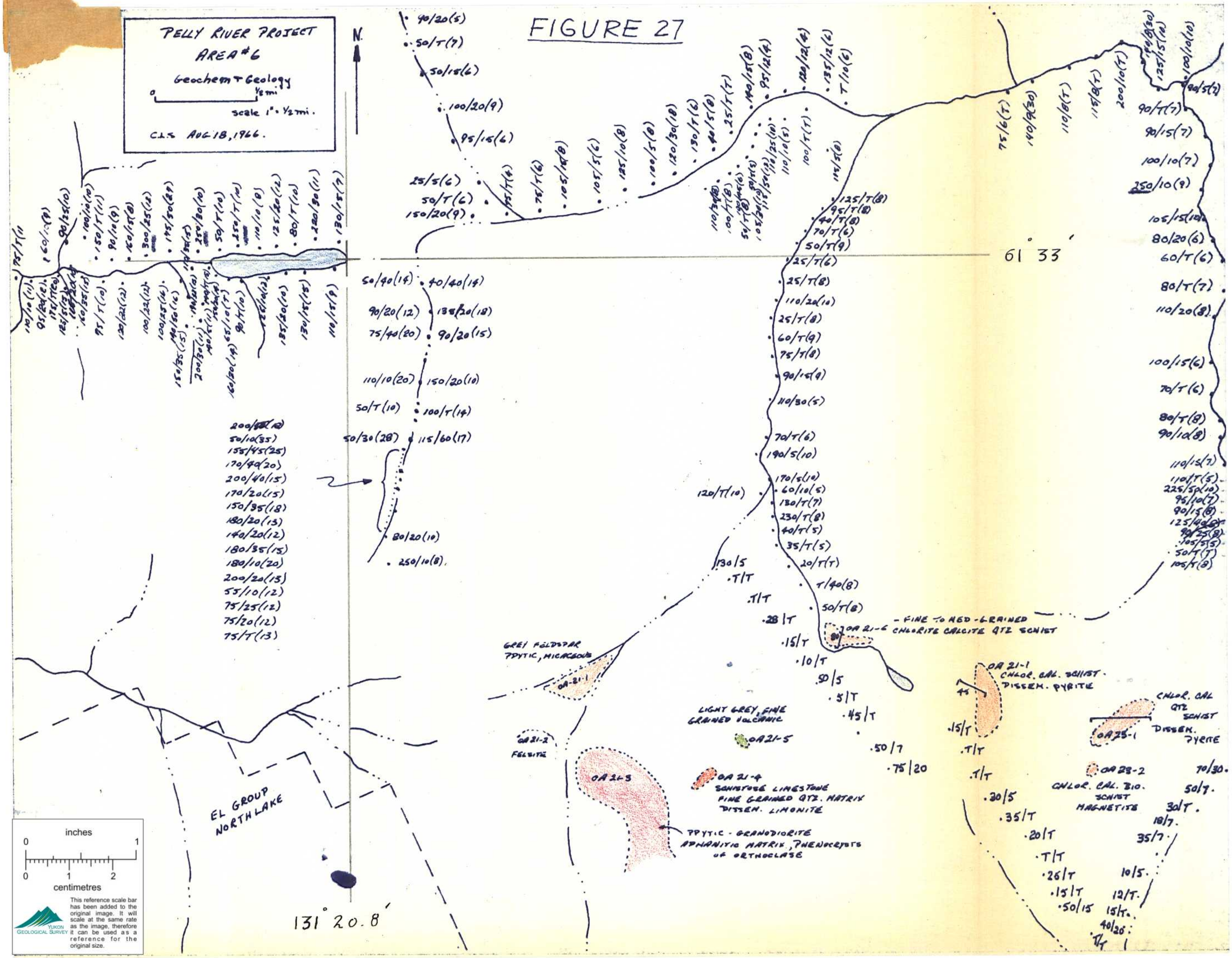


inches
0 1
0 1 2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY



131° 41.3′
61° 37.8′
RIVER
HOOLE
225/20
50/T
35/30
T/T
140/T
160/T
175/35
225/20
300/15
225/40
90/25
170/T
150/40
50/T
135/T
90/T
115/T
130/T
15/T
125/T
125/45
120/20
175/25
250/50
20/T
450/45
T/T
200/T
150/T
140/T
25/T
140/T
115/25
135/T
145/T
175/30
FIGURE 26
N
PELLY R. PROJ.
AREA #4 (SOUTH)
GEOCHEMICAL MAP
VALUES IN PPM
Zn/Cu
0
1/2
1 MI.
SCALE 1" = 1/2 MI.
C.L.S., AUG. 13, 1966.
inches
0
1
centimetres
0
1
2
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

FIGURE 27


PELLY RIVER PROJECT
AREA #6
Geochem + Geology
0 ½ mi
scale 1" = ½ mi.
C.I.S. AUG 18, 1966.
N.
61° 33'
131° 20.8'
GREY FELDSPAR PPYTIC, MICACEOUS
OA 21-1
OA 21-2 FELSITE
OA 21-3
LIGHT GREY, FINE GRAINED VOLCANIC
OA 21-5
OA 21-4 SCHISTOSE LIMESTONE FINE GRAINED QTZ. MATRIX DISSEM. LIMONITE
PPYTIC - GRANODIORITE APHANITIC MATRIX, PHENOCRYSTS OF ORTHOCLASE
OA 21-6
- FINE TO MED-GRAINED CHLORITE CALCITE QTZ SCHIST
OA 21-1 CHLOR. CAL. SCHIST. DISSEM. PYRITE
CHLOR. CAL QTZ SCHIST DISSEM. PYRITE
OA 25-1
OA 28-2
CHLOR. CAL. BIO. SCHIST MAGNETITE
EL GROUP NORTHLAKE

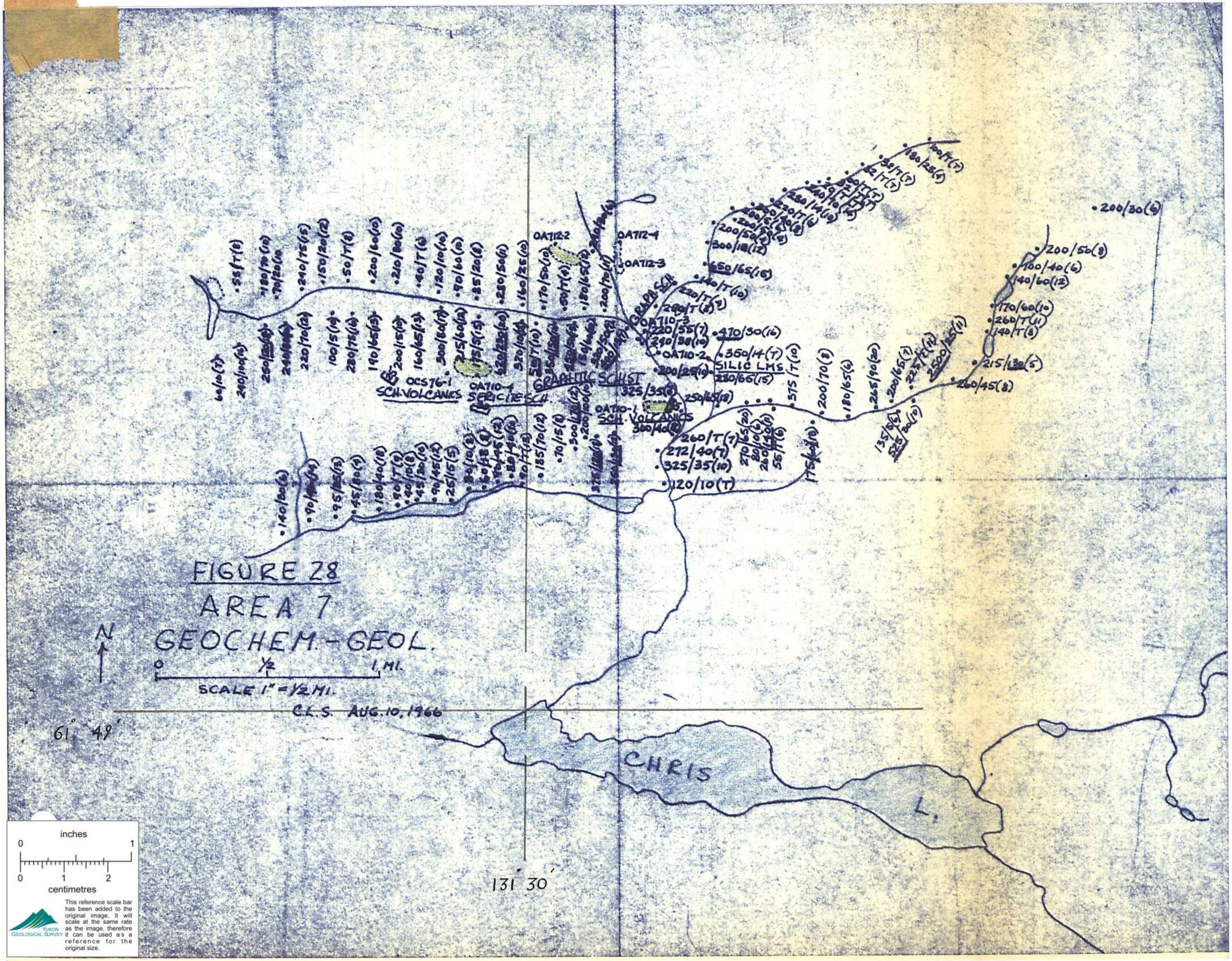
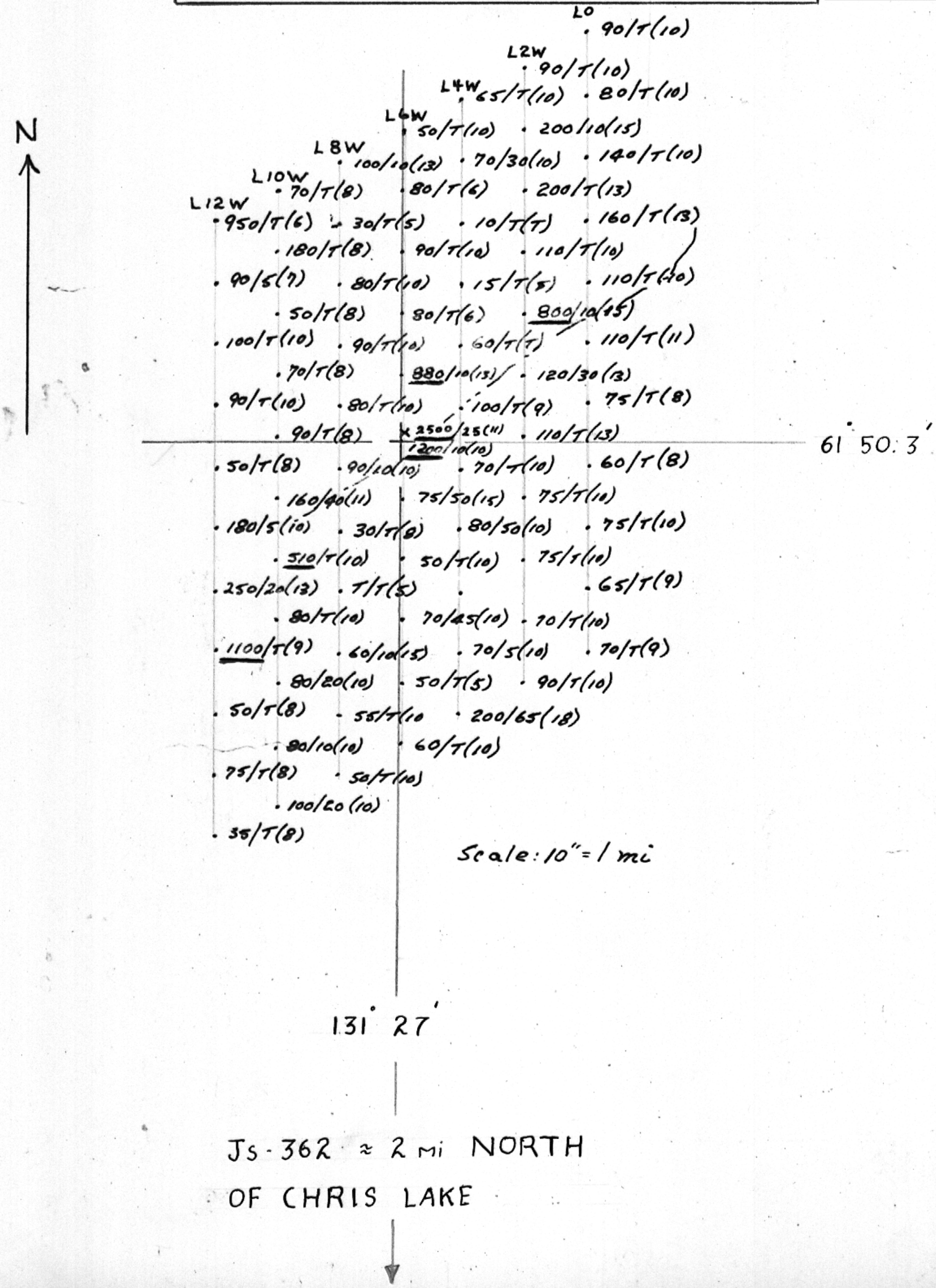
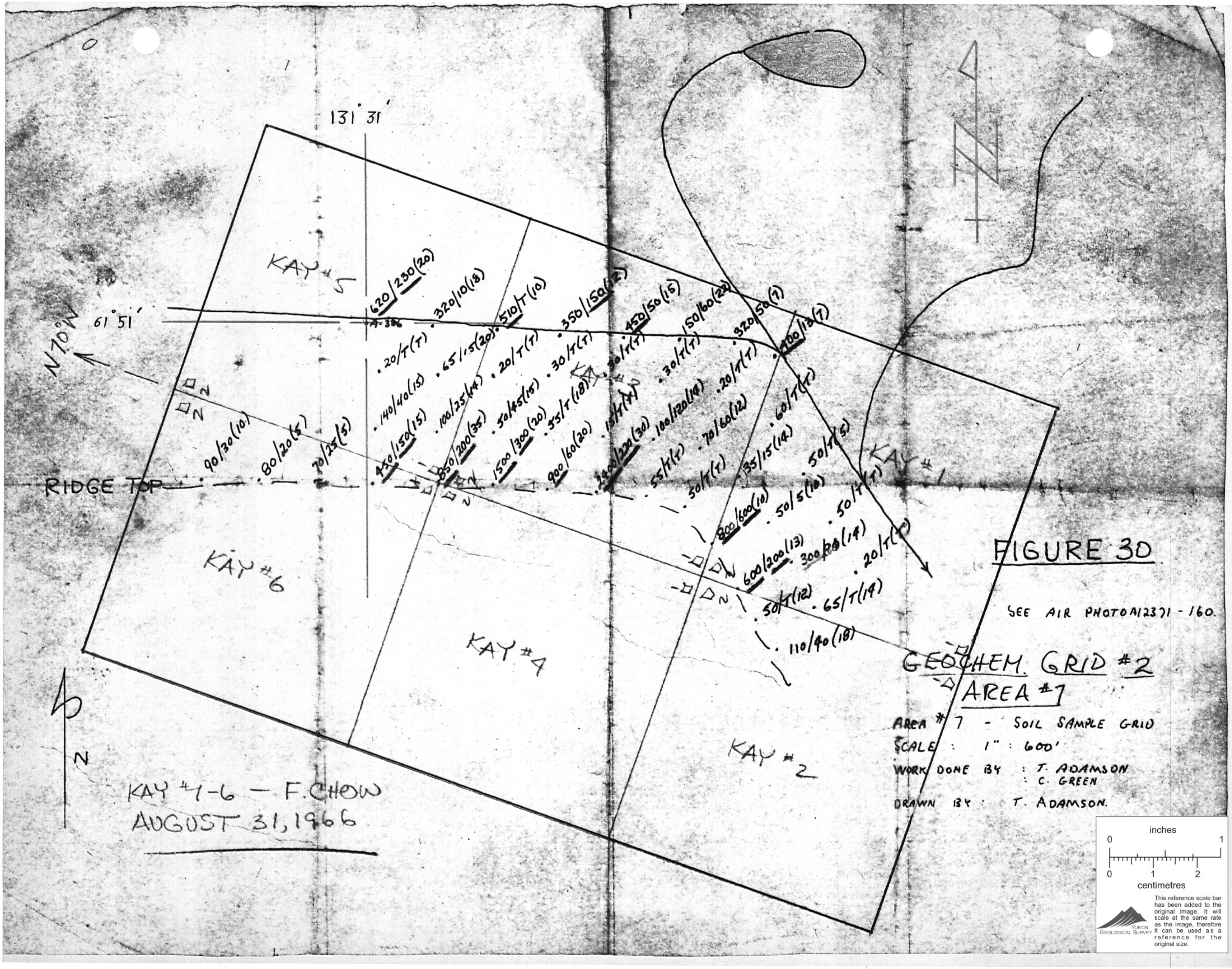


FIGURE 28
AREA 7
GEOCHEM - GEOL.
N
0 1/2 1 MI.
SCALE 1" = 1/2 MI.
C.L.S. AUG. 10, 1966
61° 49'
131° 30'
CHRIS
L.
SCH. VOLCANICS
SERICITE SCH.
GRAPHITIC SCHIST
GRAPH. SCH.
SILIC LMS
SCH. VOLCANICS
OCS76-1
OA710-4
OA710-3
OA710-2
OA710-1
OA712-2
OA712-4
OA712-3
inches
0 1
0 1 2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

FIGURE 29

Geochem. Grid in Area #7 (GRID #1)
at JS 362 (2500 ppm Zn)




131°31'
61°51'
N70°W
KAY #5
KAY #6
KAY #4
KAY #2
KAY #1
RIDGE TOP
N
FIGURE 30
SEE AIR PHOTO A12371 - 160.
GEOCHEM GRID #2
AREA #7
AREA #7 - SOIL SAMPLE GRID
SCALE : 1" : 600'
WORK DONE BY : T. ADAMSON
: C. GREEN
DRAWN BY : T. ADAMSON.
KAY #1-6 - F. CHOW
AUGUST 31, 1966

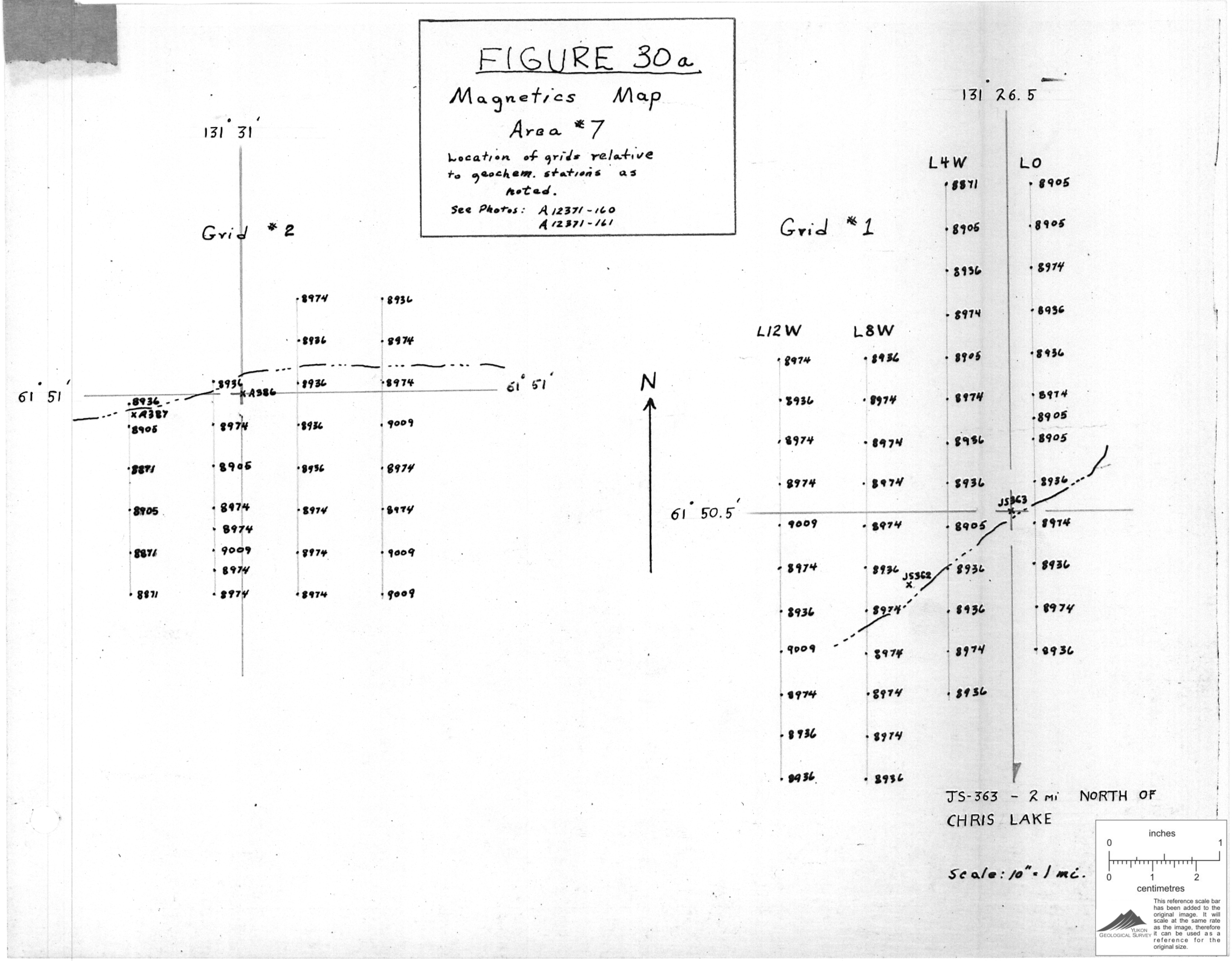
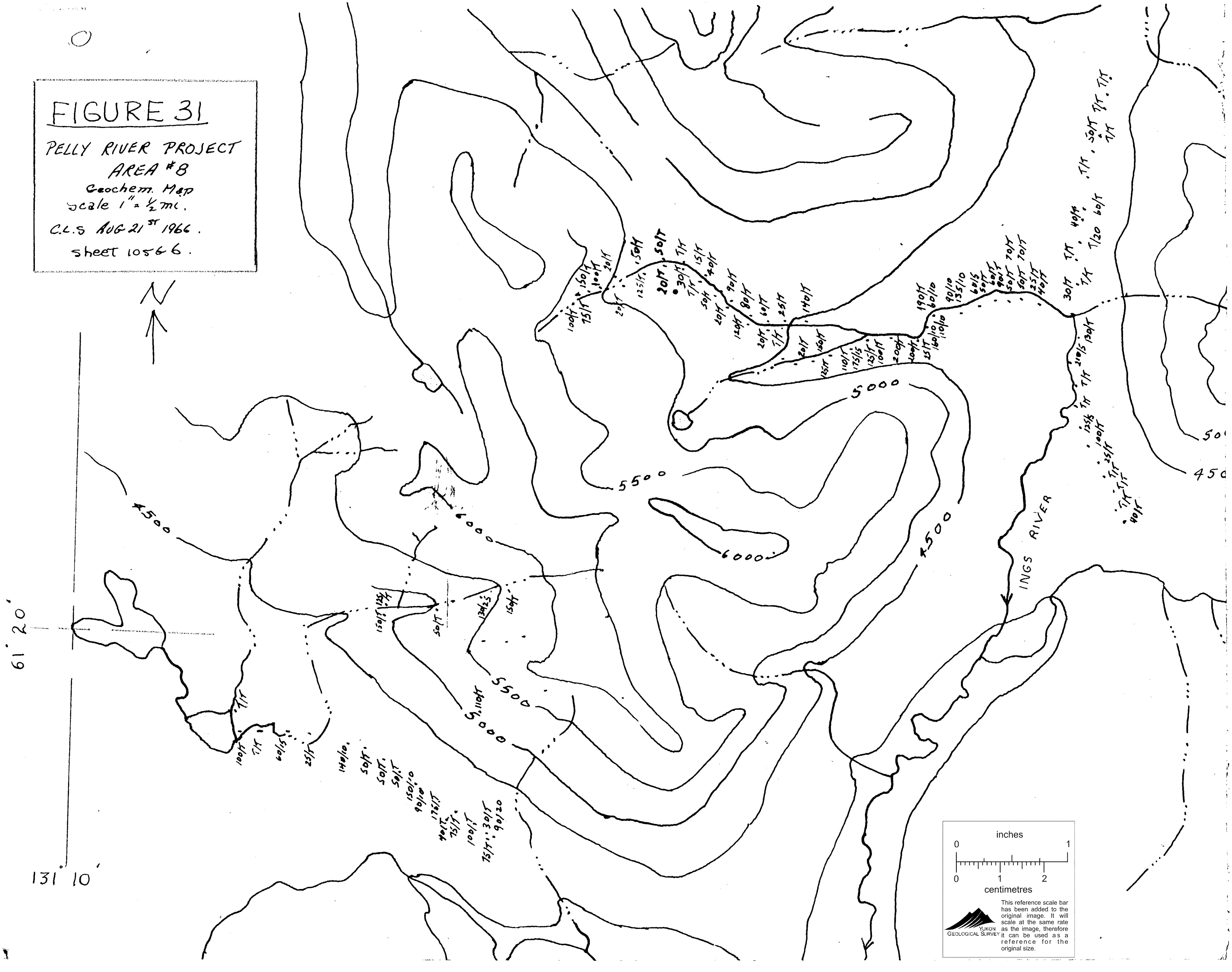
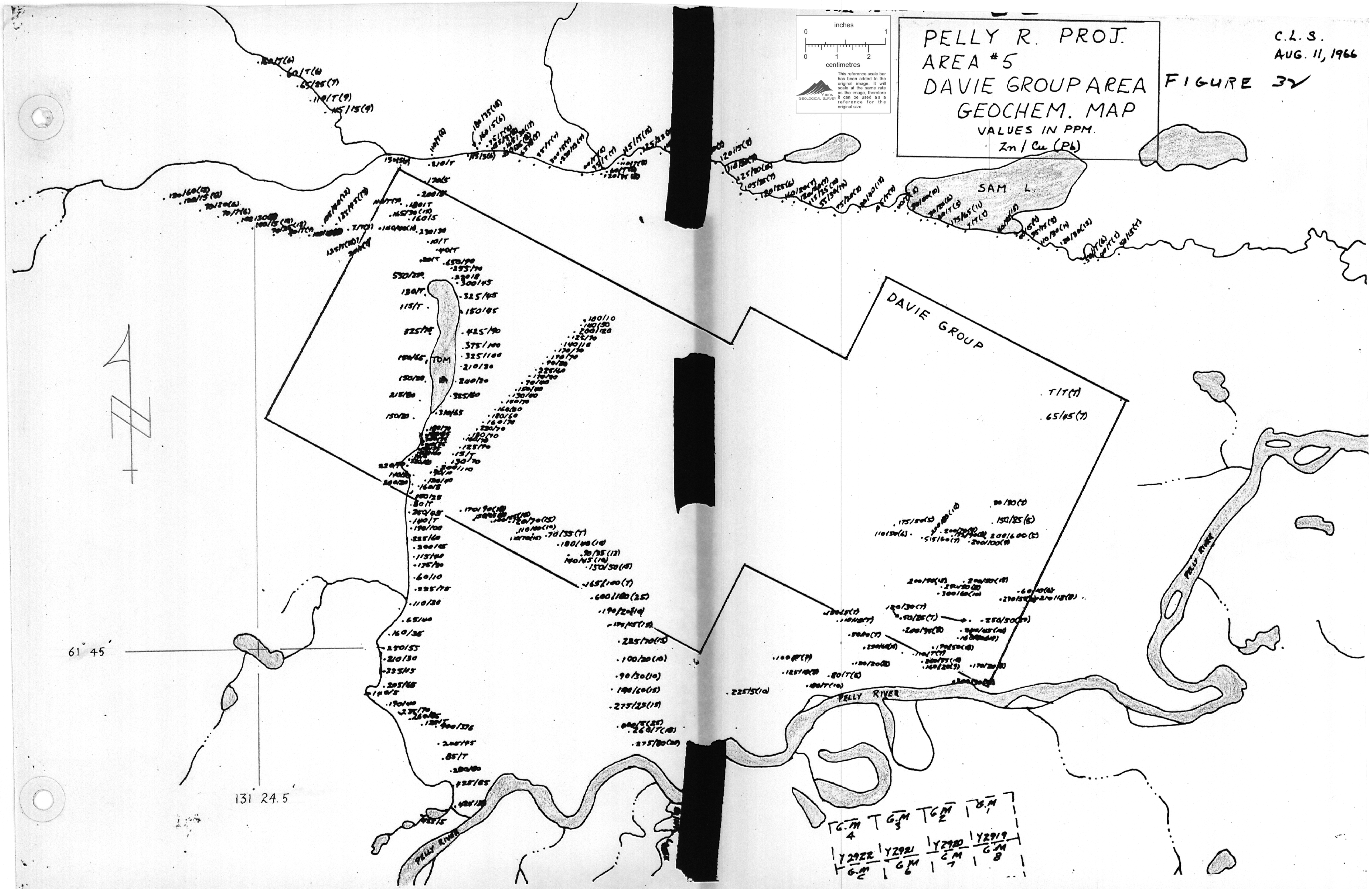


FIGURE 30a
Magnetics Map
Area #7
Location of grids relative to geochem. stations as noted.
See Photos: A12371-160
A12371-161
131° 31′
Grid #2
61° 51′
61° 51′
xA386
xA387
8936 8905 8871 8905 8871 8871
8936 8974 8905 8974 8974 9009 8974 8974
8974 8936 8936 8936 8936 8974 8974 8974
8936 8974 8974 9009 8974 8974 9009 9009
N
131° 26.5
Grid #1
61° 50.5′
L12W
8974 8936 8974 8974 9009 8974 8936 9009 8974 8936 8936
L8W
8936 8974 8974 8974 8974 8936 8974 8974 8974 8974 8936
L4W
8871 8905 8936 8974 8905 8974 8936 8936 8905 8936 8936 8974 8936
L0
8905 8905 8974 8936 8936 8974 8905 8905 8936 8974 8936 8974 8936
JS363
JS362
JS-363 - 2 mi NORTH OF CHRIS LAKE
Scale: 10" = 1 mi.
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

FIGURE 31

PELLY RIVER PROJECT
AREA #8
Geochem. Map
scale 1" = ½ mi.
C.L.S AUG 21ST 1966.
sheet 105G6.

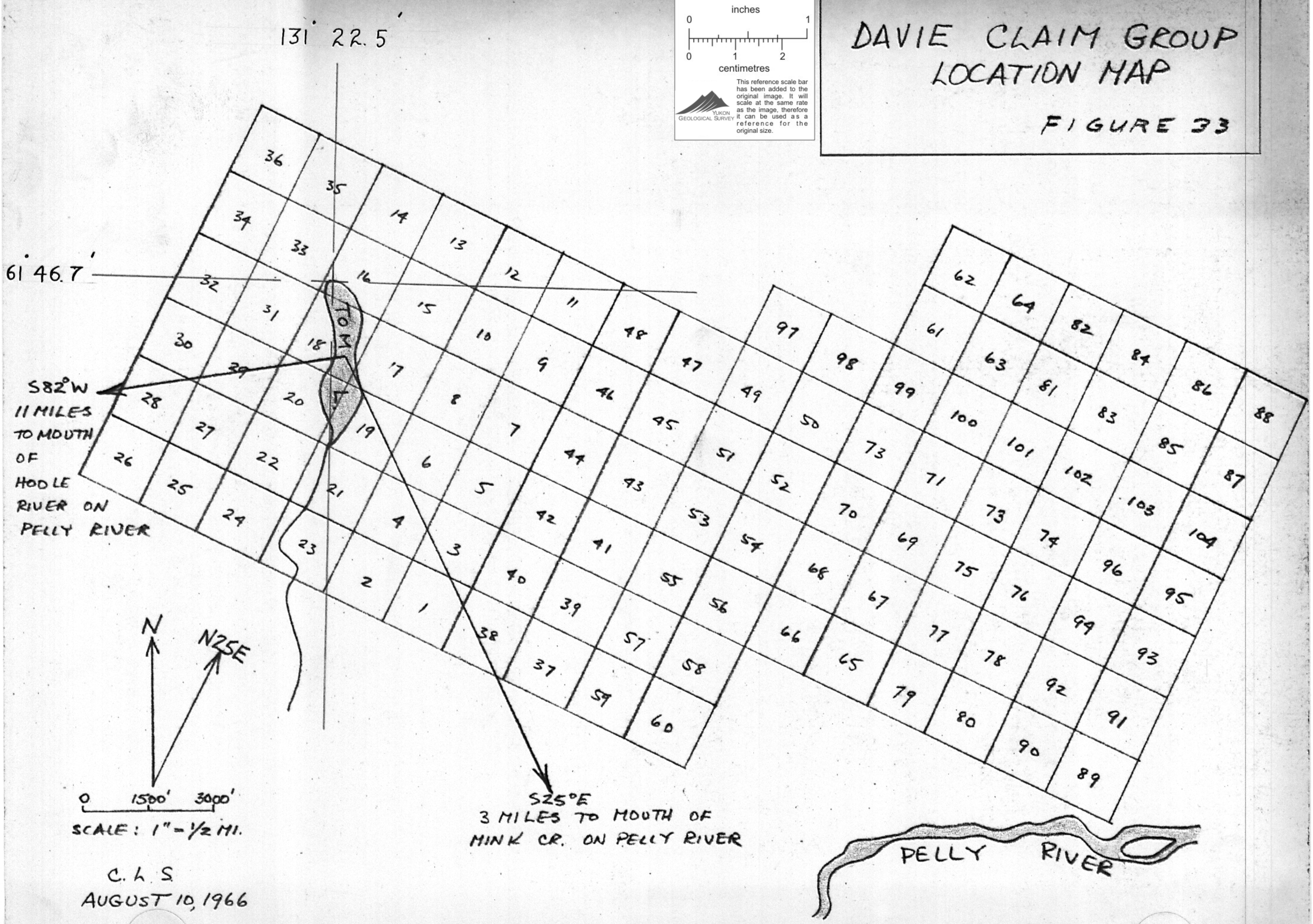




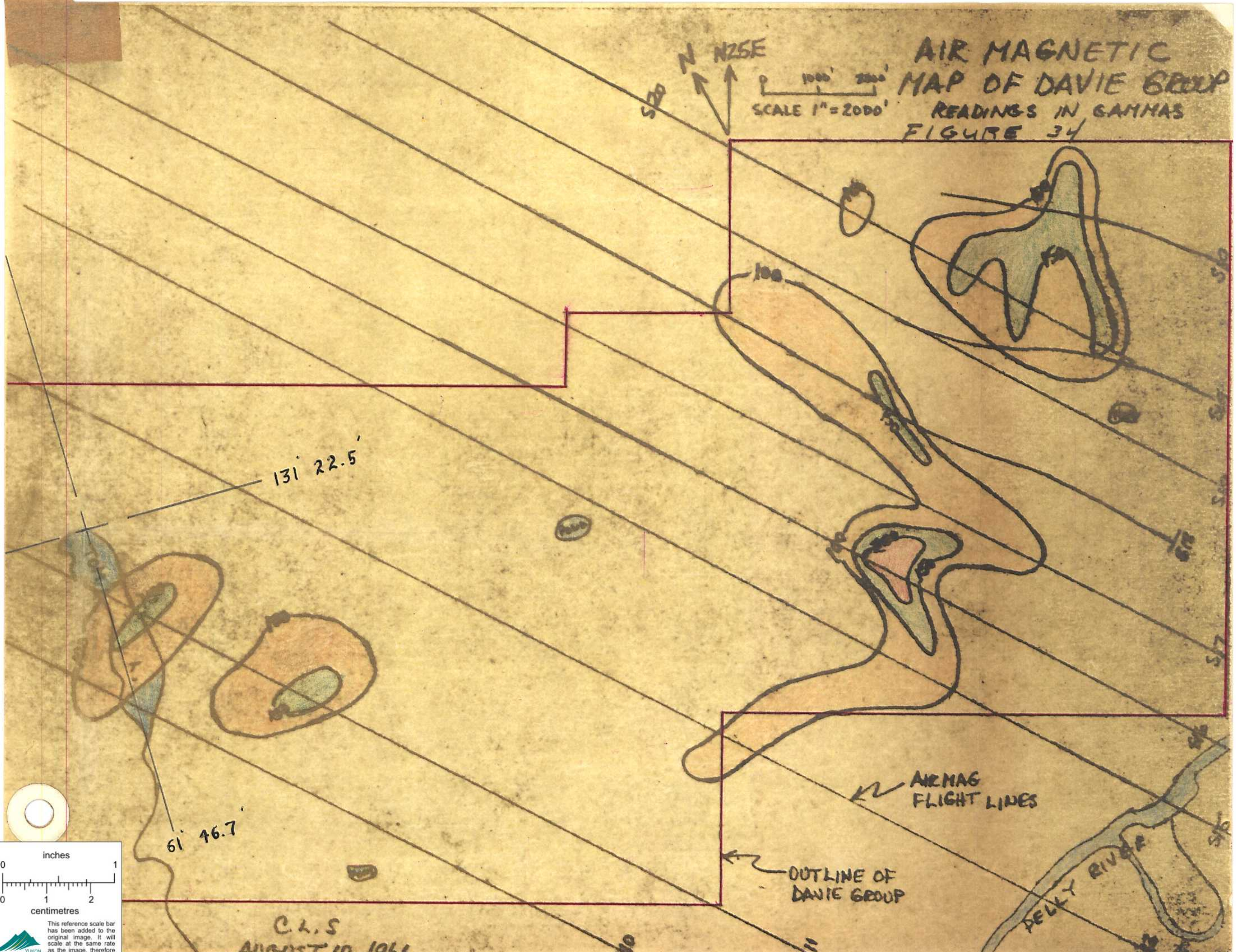
PELLY R. PROJ.
AREA #5
DAVIE GROUP AREA
GEOCHEM. MAP
VALUES IN PPM.
Zn / Cu (Pb)
C.L.S.
AUG. 11, 1966
FIGURE 32
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY
SAM L.
TOM
DAVIE GROUP
PELLY RIVER
61° 45′
131° 24.5′

DAVIE CLAIM GROUP LOCATION MAP

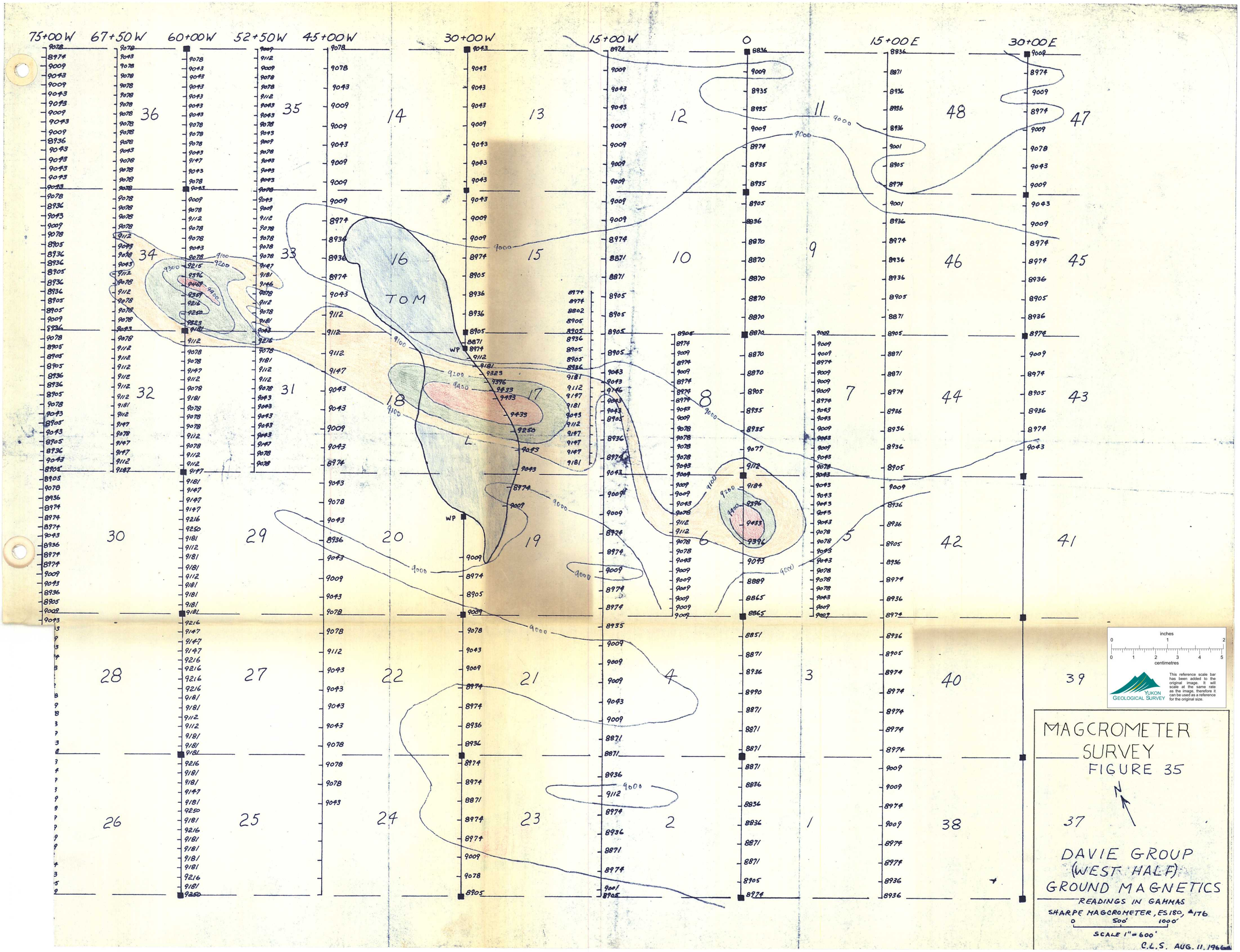
FIGURE 33



C. L. S.
AUGUST 10, 1966



AIR MAGNETIC
MAP OF DAVIE GROUP
READINGS IN GAMMAS
FIGURE 34
N
N25E
0 1000' 2000'
SCALE 1" = 2000'
131° 22.5'
61° 46.7'
AIRMAG
FLIGHT LINES
OUTLINE OF
DAVIE GROUP
PELLY RIVER
C.L.S


75+00W
67+50W
60+00W
52+50W
45+00W
30+00W
15+00W
0
15+00E
30+00E
TOM
MAGCROMETER SURVEY
FIGURE 35
N
DAVIE GROUP
(WEST HALF)
GROUND MAGNETICS
READINGS IN GAMMAS
SHARPE MAGCROMETER, ES180, #176
SCALE 1" = 600'
C.L.S. AUG. 11, 1966
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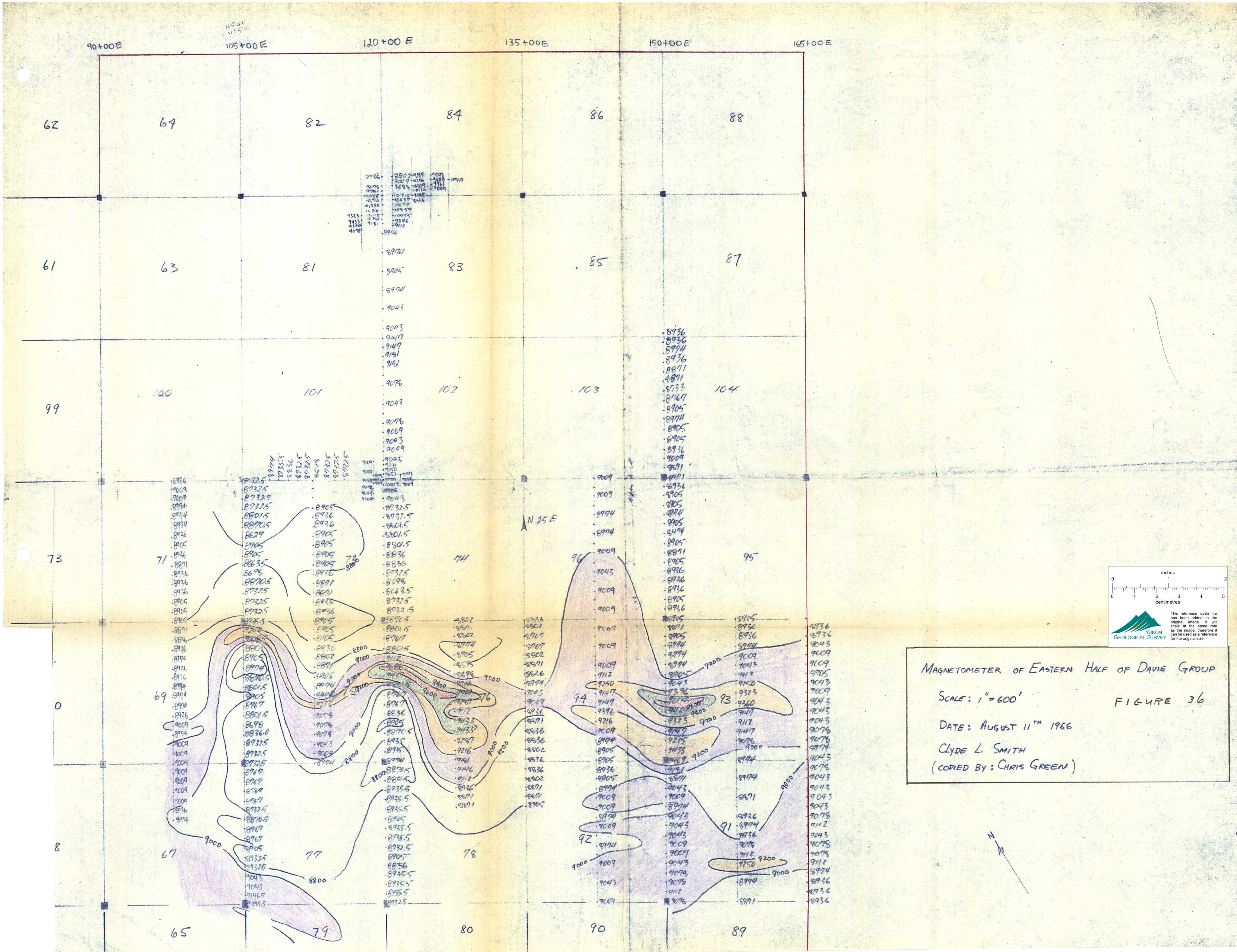
YUKON GEOLOGICAL SURVEY



MAGNETOMETER OF EASTERN HALF OF DAVIE GROUP
SCALE: 1" = 600'
FIGURE 36
DATE: AUGUST 11TH 1966
CLYDE L. SMITH
(COPIED BY: CHRIS GREEN)
90+00E
105+00E
120+00 E
135+00E
150+00E
165+00E
N 25 E
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

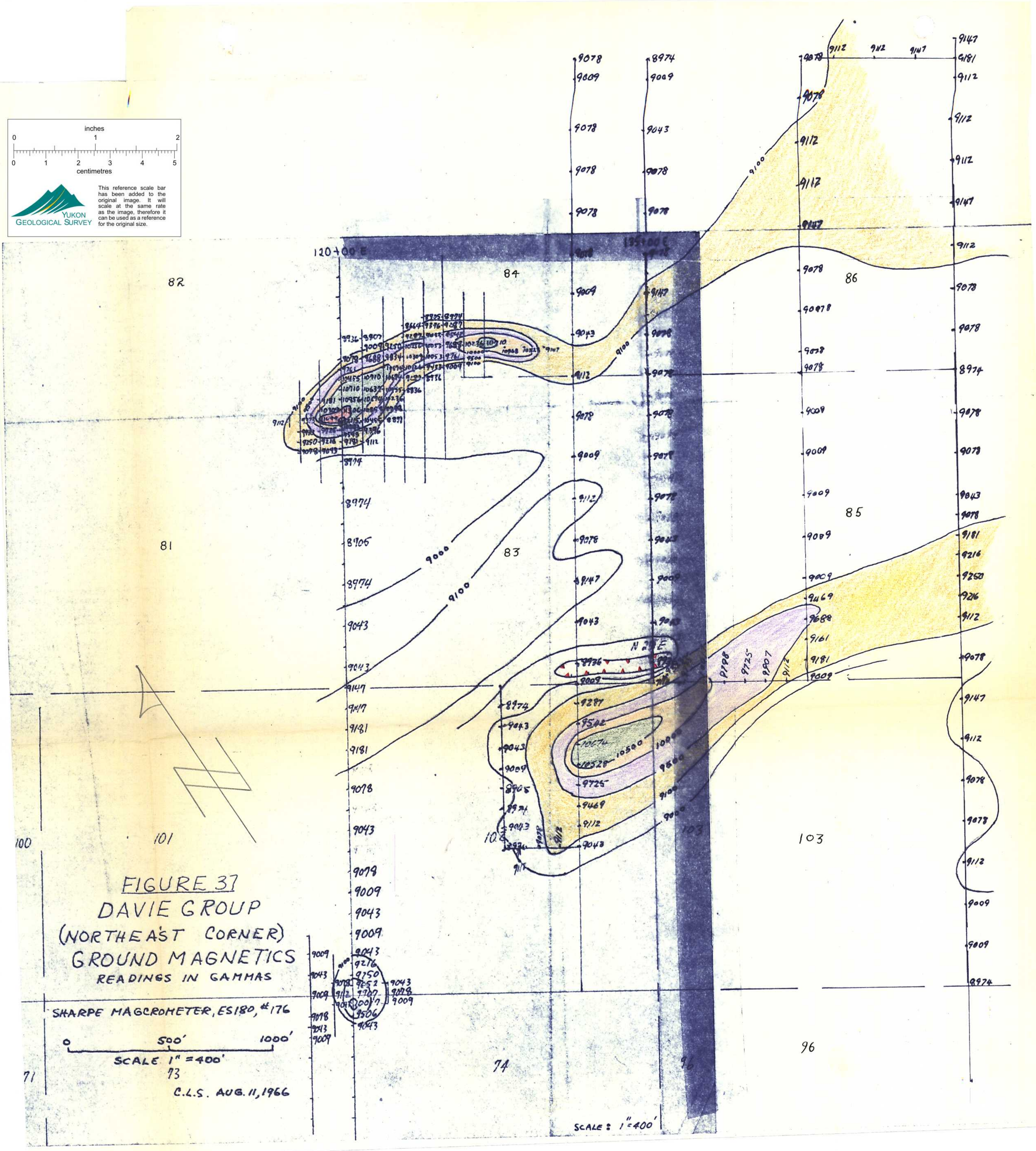


FIGURE 37
DAVIE GROUP
(NORTHEAST CORNER)
GROUND MAGNETICS
READINGS IN GAMMAS

SHARPE MAGCROMETER, ES180, #176

0 500' 1000'
SCALE 1" = 400'

C.L.S. AUG. 11, 1966


75+00 W
60+00W
45+00W
30+00W
15+00W
0+00
35
14
13
12
33
16
15
10
TOM
31
18
8
L.
29
20
19
6
27
22
21
4
25
24
23
2
FIGURE 38
N
DAVIE GROUP
(WEST HALF)
GROUND E.M.
LO HI
0 500' 1000'
SCALE 1"=600'
C.L.S. AUG. 11, 1966
inches
0 1 2
0 1 2 3 4 5
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

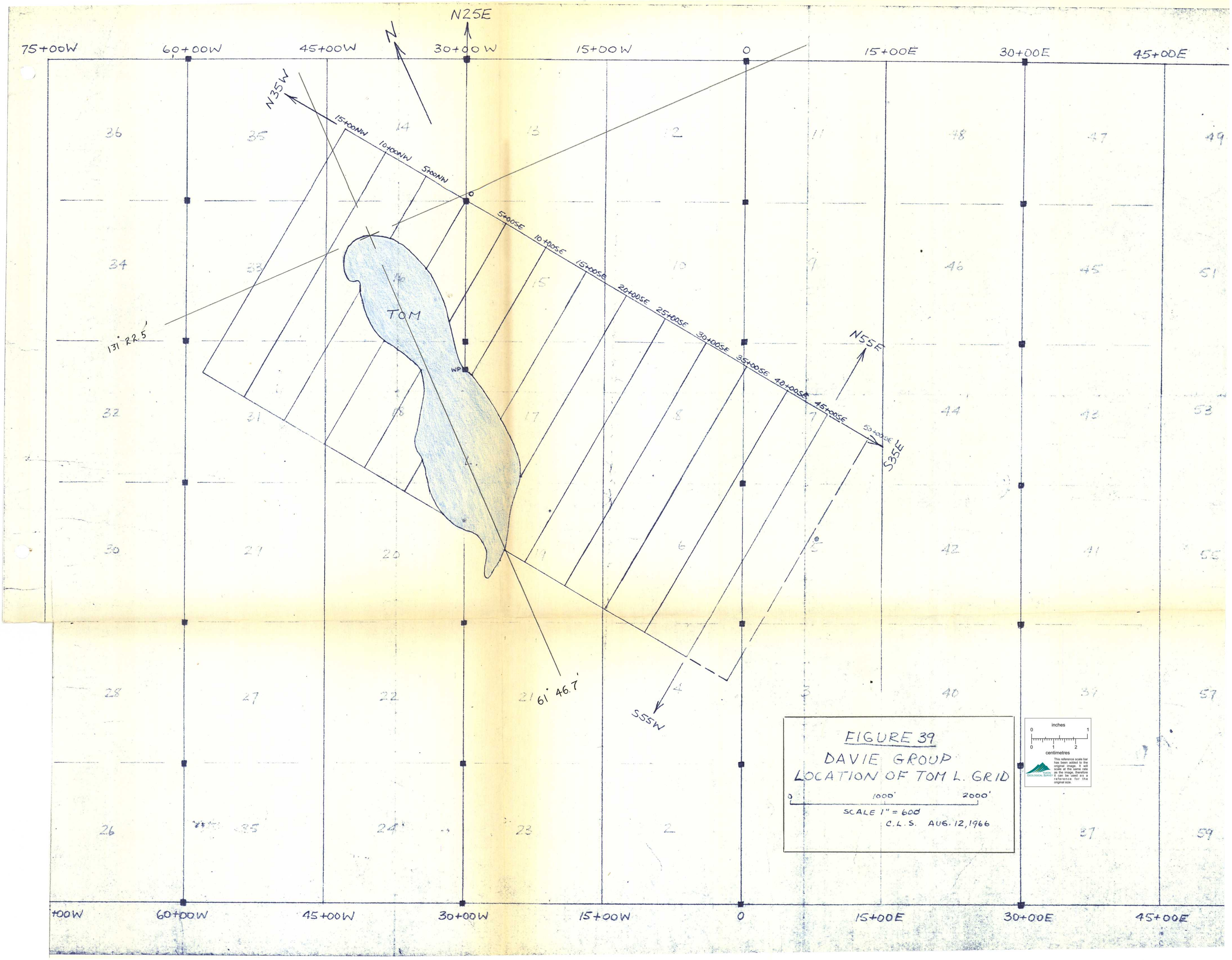


FIGURE 39
DAVIE GROUP
LOCATION OF TOM L. GRID

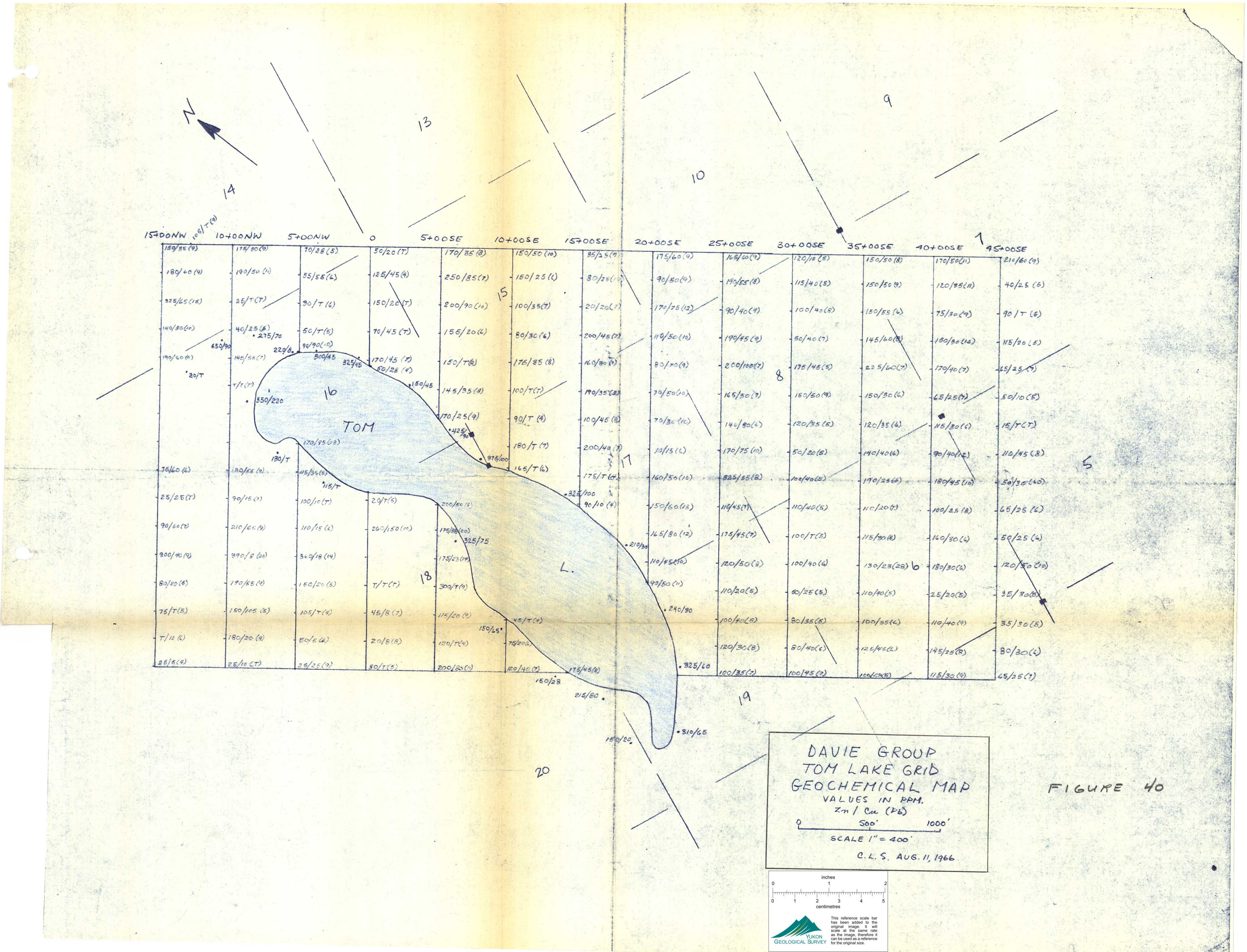
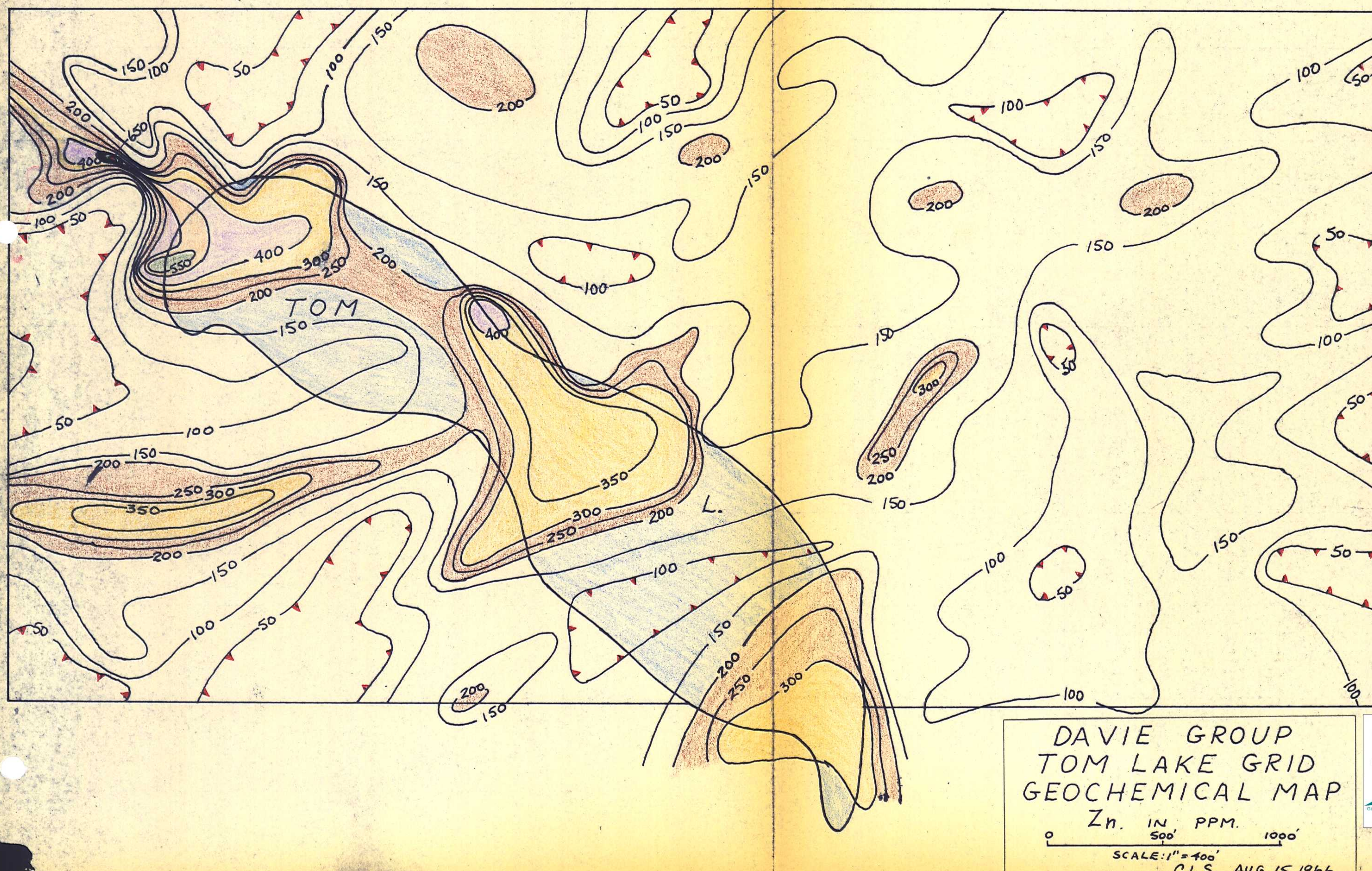

DAVIE GROUP
TOM LAKE GRID
GEOCHEMICAL MAP
VALUES IN PPM.
Zn / Cu (Pb)
0 500' 1000'
SCALE 1" = 400'
C.L.S. AUG. 11, 1966
N
15+00NW
10+00NW
5+00NW
0
5+00SE
10+00SE
15+00SE
20+00SE
25+00SE
30+00SE
35+00SE
40+00SE
45+00SE
TOM
L.
5
6
7
8
9
10
13
14
15
16
17
18
19
20
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

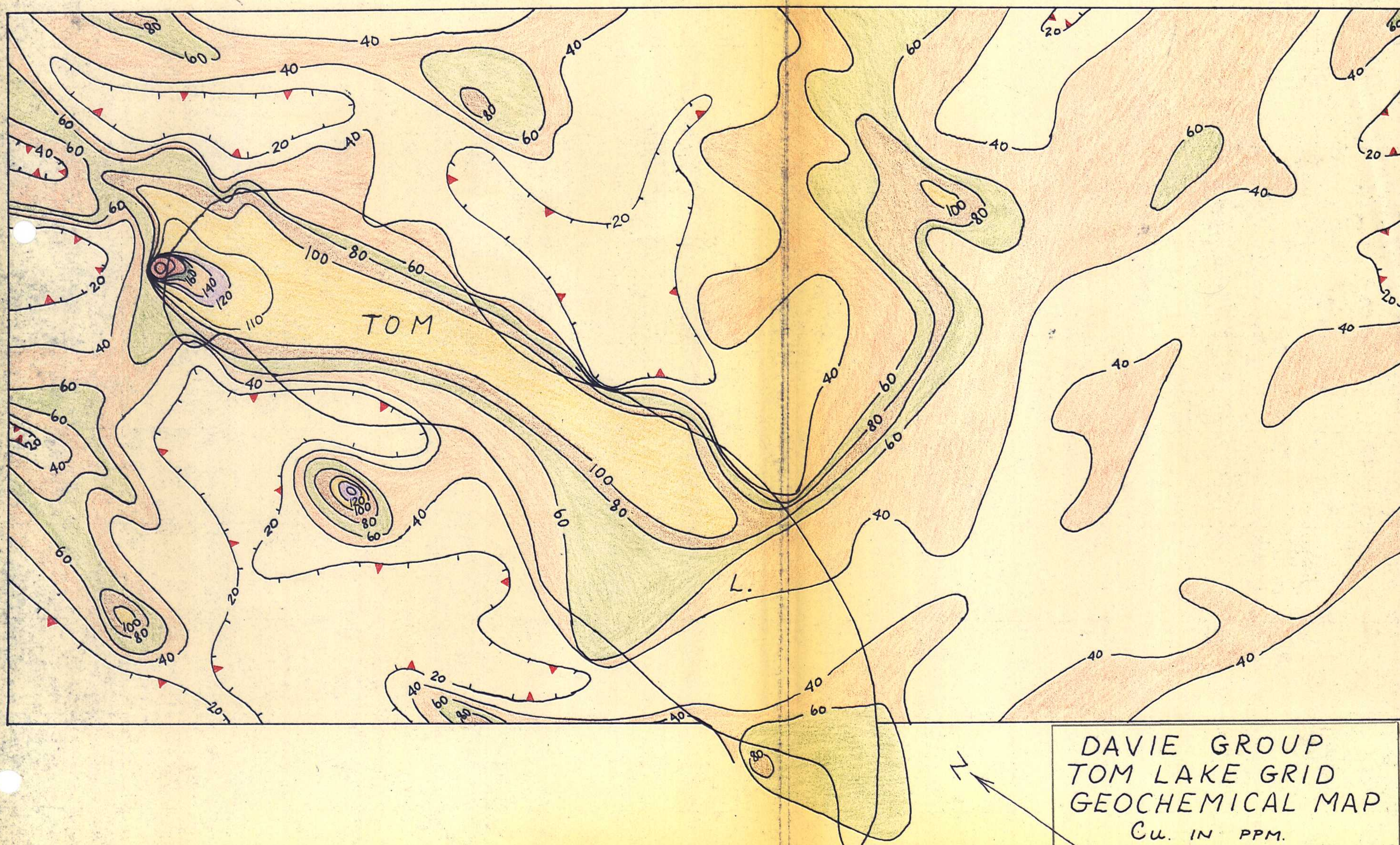
FIGURE 40

FIGURE 41



TOM
L.
DAVIE GROUP
TOM LAKE GRID
GEOCHEMICAL MAP
Zn. IN PPM.
0 500' 1000'
SCALE: 1" = 400'
CLS AUG. 15, 1966

FIGURE 42



DAVIE GROUP
TOM LAKE GRID
GEOCHEMICAL MAP
Cu. IN PPM.

0 500' 1000'
SCALE: 1" = 400'

C.L.S. AUG. 15 1966

inches
0 1
0 1 2
centimetres

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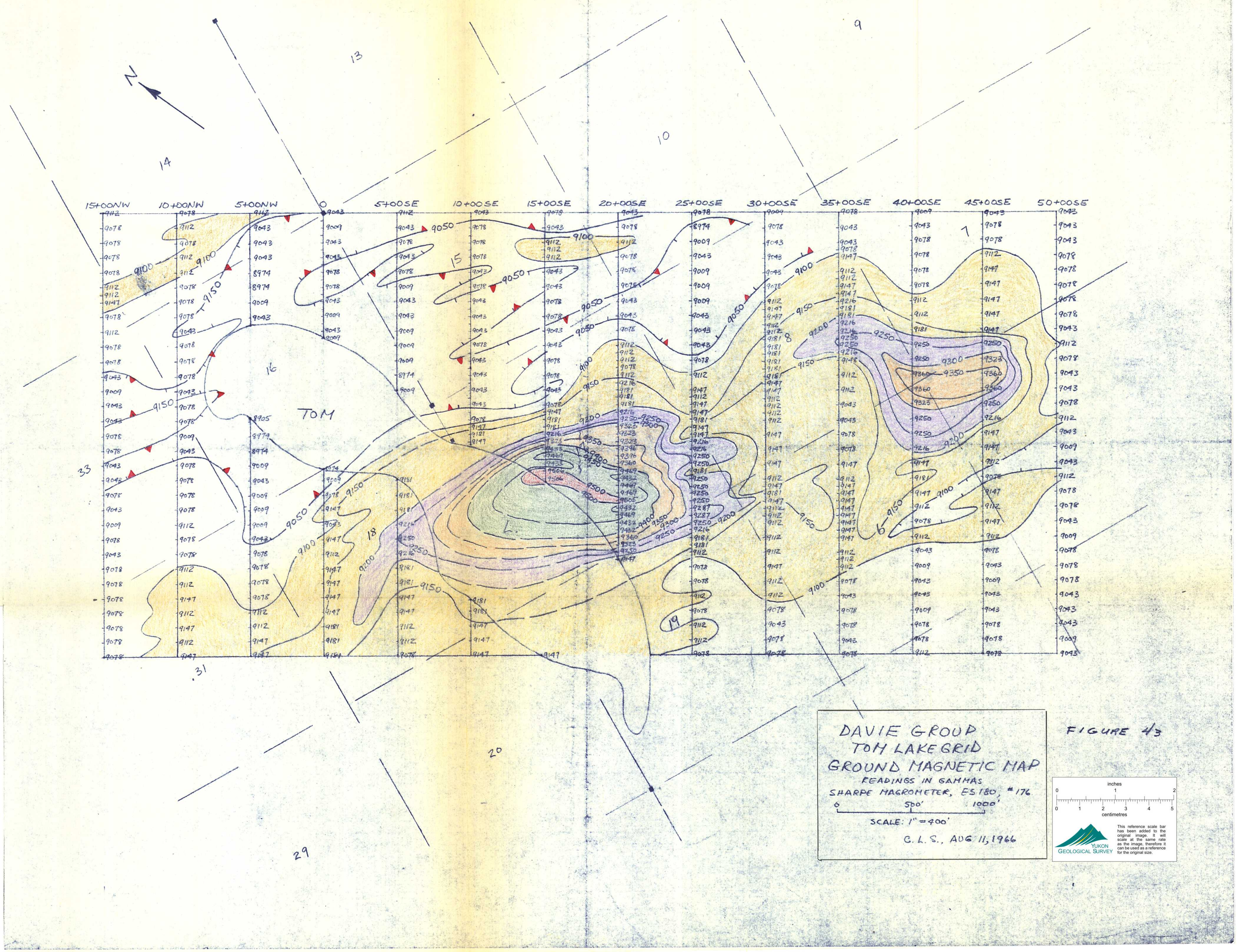
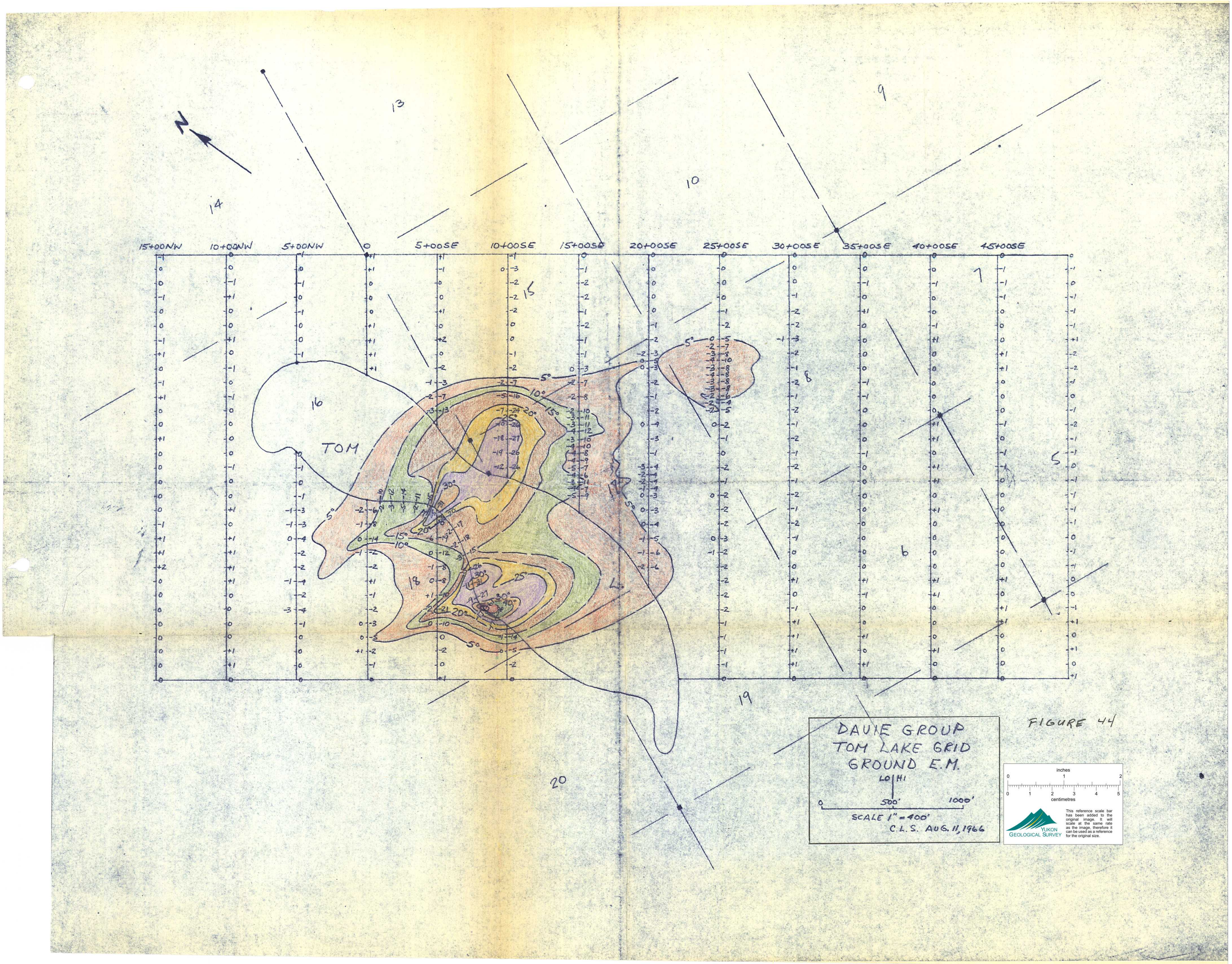
Yukon Geological Survey



DAVIE GROUP
TOM LAKE GRID
GROUND MAGNETIC MAP
READINGS IN GAMMAS
SHARPE MAGROMETER, ES 180, #176
0 500' 1000'
SCALE: 1" = 400'
C. L. S., AUG 11, 1966
FIGURE 4/3
N
TOM
15+00NW
10+00NW
5+00NW
0
5+00SE
10+00SE
15+00SE
20+00SE
25+00SE
30+00SE
35+00SE
40+00SE
45+00SE
50+00SE


N
15+00NW
10+00NW
5+00NW
0
5+00SE
10+00SE
15+00SE
20+00SE
25+00SE
30+00SE
35+00SE
40+00SE
45+00SE
TOM
DAVIE GROUP
TOM LAKE GRID
GROUND E.M.
LO HI
0
500'
1000'
SCALE 1" = 400'
C.L.S. AUG. 11, 1966
FIGURE 44

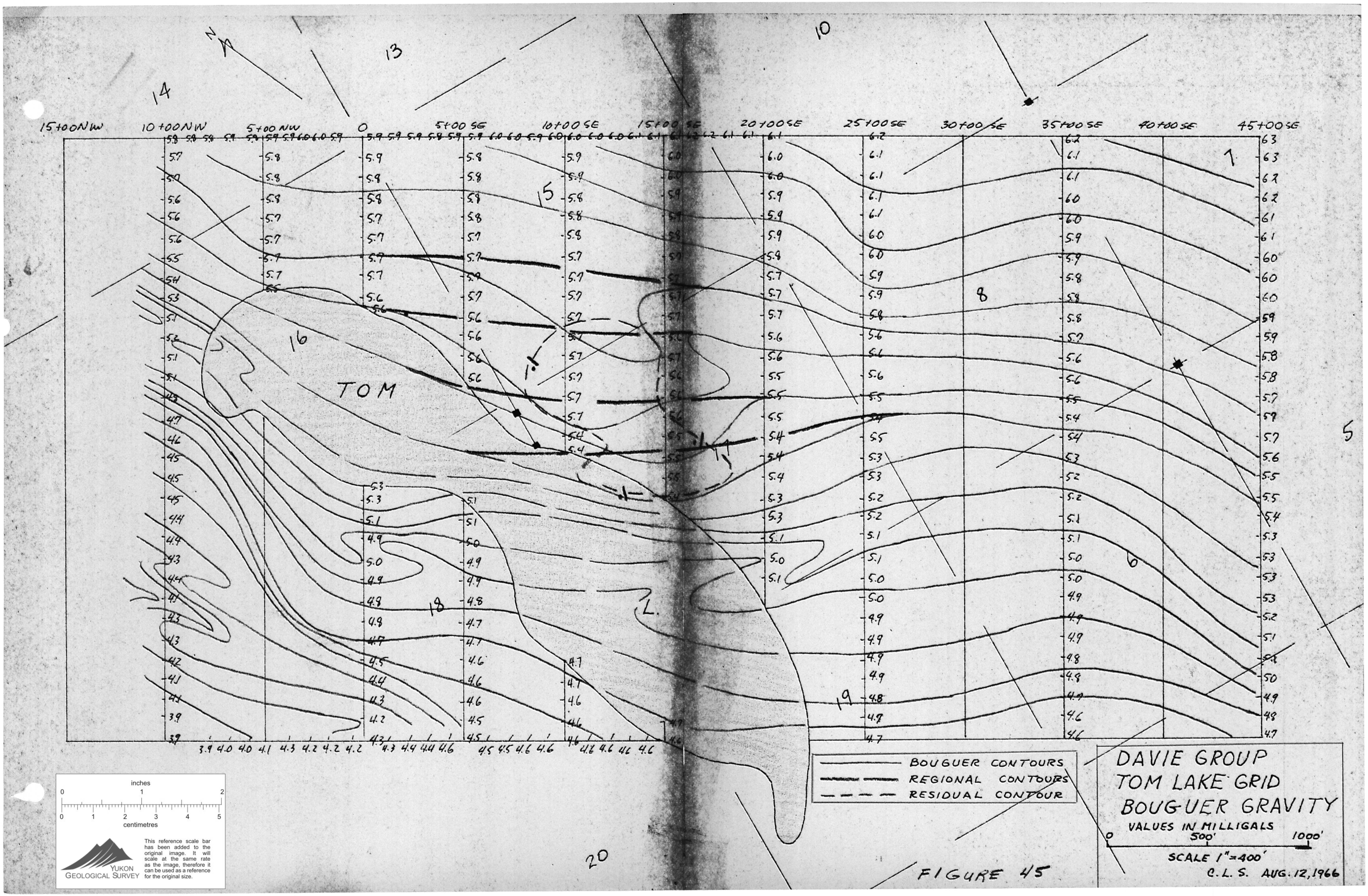

15+00NW
10+00NW
5+00NW
0
5+00SE
10+00SE
15+00SE
20+00SE
25+00SE
30+00SE
35+00SE
40+00SE
45+00SE
TOM
BOUGUER CONTOURS
REGIONAL CONTOURS
RESIDUAL CONTOUR
DAVIE GROUP
TOM LAKE GRID
BOUGUER GRAVITY
VALUES IN MILLIGALS
0
500'
1000'
SCALE 1"=400'
C.L.S. AUG. 12, 1966
inches
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
YUKON GEOLOGICAL SURVEY

FIGURE 45

FIGURE 46

STATISTICAL GRAPHS OF Zn AND Cu
FOR ALL AREAS SURVEYED

DRAFTED BY:- R.DARNEY

AUGUST 28, 1966. C.L.S.