FORT CHIPEWYAN ORNAMENTAL-BUILDINGSTONE PROJECT : CHIPEWYAN RED GRANITE

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SUMMARY

This report outlines the current status of the Chipewyan red granite project. The objective of the investigation is to determine the suitability of the granite, located in northeastern Alberta along the margin of the Canadian Shield, for use as ornamental buildingstone.

1970

Reconnaissance geological mapping by the Research Council of Alberta in the summer of 1970 revealed and delineated a body of red granite 15 miles long by 3 to 4 miles wide (approximately 50 sq mi).

1971

A helicopter reconnaissance of the southern section of the red granite pluton adjacent to the commercial tug and barge route along the Slave River was undertaken in September, 1971. A number of hand specimens and five large blocks from 3/4 to 1 cubic foot in size were obtained. These were cut and polished by a commercial firm in Edmonton, and the results indicate that the material has considerable potential for use as ornamental buildingstone.

1972

Helicopter reconnaissance of the granite body (pluton) was undertaken in the early part of the field season to assess the gross lithologic and structural characteristics of the pluton and to outline specific areas for more detailed work. Three sites in the southern part of the pluton were selected initially for preliminary mapping. On the basis of color, texture, and fracture patterns, one of these sites (No. 16, Fig. 1) was chosen for detailed study and sampling. Outcrop was cleaned by hydraulic sluicing, and numerous hand specimens and large blocks were collected for cutting and polishing.

SEQUENCE OF EXPLORATION ACTIVITIES, 1972

The general sequence of exploration activities involved in delineating potential quarry sites is summarized in table 1.

Stage 1

Reconnaissance of the entire pluton was undertaken by helicopter in the early part of the field season (Fig. 1). The northern one-third to one-half of the pluton has a noticeable ferromagnesian mineral content with associated gneissic banded structure. The northern two-thirds of the pluton also is extensively fractured; therefore, this area was automatically eliminated from further consideration.

Stage 2

A general ground reconnaissance was made at eight sites selected in the course of the 1972 helicopter survey. Seven of these sites are located in the southern one-third of the pluton (Fig. 1). Their ornamental buildingstone potential was graded according to both the outcrop fracture system and the texture-color quality as seen in the hand specimen (Table 2). The three "A" sites were further evaluated by means of a preliminary geological study (stage 3).

Stage 3

The three sites (Nos. 11, 15 and 16) were mapped initially on the basis of fracture frequency followed by hand specimen sampling in the relatively fracture-free areas delineated within the general site. Site 15 is an exception to this procedure: nearby site 16 looked so promising in the early stages of preliminary mapping that full attention was given to it before hand specimens were collected from site 15. Results of mapping at the three sites are summarized in figures 2, 3 and 4.

Stages 4, 5, 6 and 7

Site 16 was selected as the prime site for further investigation on the basis of fracture frequency and fracture pattern. Hand specimens were collected (locations shown in Fig. 5), and five potential quarry areas were delineated (Fig. 4).

Table 1. Summary of Exploration Activities and Progress

Exploration Stage	Exploration Activity	Time-Input (geol. man/days)	Period of Activity
1	Aerial reconnaissance of the whole pluton (50 sq mi).	3/4	May 25 - 26
2	General ground reconnaissance at 8 selected sites.	3/4	May 25 - 26
3	Preliminary ground study at 3 selected sites.	2	May 27 - 28
4	Detailed ground study at one selected site (Site 16).		
5	Fracture pattern assessment at Site 16.		
6	Hand specimen survey at Site 16.	1	May 28
7	Five prime areas outlined within Site 16.		
8	Six test block sites chosen, drilled and blasted.	2-1/2	May 29 - June 13
9	Sluicing and cleaning of outcrop; detailed geological mapping and sampling.	6	June 16 - 20
10	Selection and rating of high potential quarry stone sites.	1	July 3
11	Diamond drill core exploration of high potential sites; plane-table mapping.		(Summer, 1972)

Table 2. Rating of Buildingstone Sites

Site No.	Classification
10	C
11	A
12	C
15	A
16	A
17	C
18	B
19	B

After completion of exploration, stage 2 (see Table 1)

"A" = Excellent prospects; "B" = Fair prospects; "C" = Poor prospects

Stage 8

Within these five areas (A, B, C, D and E) six sites (Fig. 5) were chosen for drilling and blasting to obtain blocks from 2 to 3 cubic feet in size, suitable for cutting and polishing by large commercial-scale equipment. Blasting made cuts up to two feet deep, from which it became evident that the fresh rock basically has a rich red color which appears sufficiently uniform to meet architectural specifications.

Study of available aerial photographs of the region (scales 1:40,000 and 1:20,000) revealed little information useful in this type of study. Consequently, low-level vertical photography was undertaken from a helicopter to obtain an improved record of the overall fracture patterns and their distribution. The area of immediate interest at site 16 falls within a rectangle 700 x 500 feet, aligned in a north-south orientation (Fig. 4).

Stage 9

The next step in the assessment process required a detailed geological examination of clean outcrop surfaces from which moss, lichen, and other loose debris was removed by hydraulic sluicing and scraping. From such outcrop surfaces the following aspects of the granite body could be evaluated:

(a) fractures - quality, pattern, frequency;
(b) rock color variations;
(c) textural factors - e.g., pegmatite and other textural variations;
(d) quartz vein distribution and frequency;
(e) mineralogical variations - especially bands and lenses of ferromagnesian mineral concentrations (i.e., gneissosity).

Stage 10

The factors listed under stage 9 were evaluated following cleaning of the outcrop surface, and sets of hand specimens were obtained from 10-foot grids at five potential quarry sites.

Stage 11

Diamond drilling was not carried out during the 1972 field season.

GEOLOGICAL EXPLORATION OF THE FORT CHIPEWYAN RED GRANITE

This portion of the report presents the specific geological data and conclusions gathered at the several stages and levels of examination as relevant to the exploration program summarized in table 1.

Stage 2 - General Ground Reconnaissance at Ten Selected Sites

Based on the Stage 1 helicopter reconnaissance survey, ten sites were selected for a general ground check (Stage 2) and these geologic data are presented below:

Site 10: an area some 200 feet square with relatively few fractures in terms of local conditions, has fracture spacings from 2 to 4 to 6 feet. Fracture frequency increases towards the river on the west. Color and texture both vary. Color ranges from deep-red to grey, some of the lighter patches coincide with fractures and others appear related to a one inch thick exfoliation skin. Textural variations are minor; the rock is typically of medium grain and includes diffuse, small pegmatitic bodies which make up much less than one percent of the rock. One quartz vein up to two inches wide was observed and therefore this occurrence seems to be of little consequence. Site 10 also includes the location used for the collection of sample 19, Rocks of Alberta Project, 1970.

Conclusion: fracture frequency appears too great over the site generally and the relatively massive area is too small. Textural variations are minor and color variations are regarded as surficial and probably inconsequential.

Site 11: several areas at least 50 to 100 feet across have widely spaced joints; a number of joint-faced blocks from 1 1/2 to 30 cubic feet in size have accumulated at the foot of one 15 foot high scarp on the west side of the site. Small areas locally

have excellent deep-red color but color variations to light-red were noted. Rock is generally mafic mineral poor; both minor gneissic mineral banding and minor diffuse pegmatites were observed.

Conclusion: prime site, needs further evaluation.

Site 12: two areas about 50 x 80 feet in size of relatively massive rock located, otherwise site is well jointed. Both texture and color are variable, the latter ranging from deep- to light-red to pink to grey and blue-brown. Texture ranges from medium- to coarse-grained.

Conclusion: relatively massive area is too small to afford an adequate quarry operation and both texture and color are variable.

Site 13: joint spacing approaches sheeting in many places, and jointing commonly occurs in three directions. There are no massive areas. Diffuse gneissic banding, quartz veins and epidote-filled fractures all contribute to the unsuitability of this rock.

Conclusion: both jointing frequency and rock quality prevent this rock from being worthy of further exploration.

Site 14: widespread closely-spaced jointing is combined with mylonitization and shearing of the rock at this site. Textural and compositional variations include gneissic banding, irregular textural variations, and quartz veins.

Conclusion: site is unsuitable on account of both jointing frequency and textural-compositional variations.

Site 15: areas at least 100 x 100 feet of relatively massive rock have been located within other well-jointed sections. Textural and compositional variations include minor hornblendic to amphibolitic bands in a medium-grained rock of good red color with some mauve areas. Minor quartz veins up to two inches wide appear to present no problem.

Conclusion: site merits further study on the basis of substantial 'massive' areas and good rock color.

Site 16: large relatively massive areas on steep (10 degree) hill slopes are separated by fault-controlled gullies with associated shear zones. Joint spacing is commonly from 2 1/2 to 5 1/2 feet in the massive areas. Color ranges little from medium- to deep-red over extensive areas with local "leaching" adjacent to the fault zones. Texture is largely medium grained with minor, diffuse-bordered or irregular margined small pegmatites and rare quartz veins up to two inches wide.

Conclusion: best prospect examined so far, good chance for obtaining large blocks with good rock color. There could be other areas in and around sites 15 and 16 which merit examination.

Site 17: extensively jointed but small relatively massive area 50 x 110 feet available. Color fairly deep-red, medium-grained rock with minor variations including pegmatite and quartz veins.

Conclusion: area of massive rock is relatively small, provides secondary target area if needed.

Site 18: small area 50 x 100 feet of relatively massive rock on north side outcrop. At highest point, nine foot high scarp shows fewer fractures with depth from surface. Rock has good deep-red color, medium-grained texture with typical textural variations of minor pegmatite and quartz veins.

Conclusion: massive area small, will provide a good secondary target area.

Site 19: some relatively massive areas with joint spacing from 2 to 6 feet are situated within larger areas having more closely spaced joints. Texture and composition fairly uniform; medium-grained rock with minor mafic clots and streaks. Color is deep-red with light grey "leach" zones.

Conclusion: merits classification as a good secondary target area.

Stage 3 - Preliminary Ground Study at Three Selected Sites

From the eight sites examined at the stage 2 level, the three sites of greatest potential were selected for further study.

Site 11: on the basis of fracture frequency in outcrop, four smaller areas were isolated and mapped using a base-line for control based on a knotted rope and compass survey (Fig. 2). These four areas are described individually below.

Area "A": fracture distribution and density are not uniform within the area blocked out. Examination of 3 to 9 foot high scarp faces showed the presence of a few gently dipping fracture surfaces with 2 to 4 foot spacing. Some vertical to steeply dipping fractures terminate at these flatter fracture surfaces, extending both from the surface downwards and less commonly from depth upwards towards the surface. Fracture zones are typically single fracture surfaces, less than 10 percent having an en echelon pattern. Some 90 percent of the fractures are systematic in type, as opposed to being non-systematic (irregular) in plan, and are fairly extensive, being in the master or major joint category. These remarks on fracture continuity and geometry are of general application to all outcrops of the Chipewyan red granite which have been studied in some detail. As might be expected, wherever gneissic banding is evident one potential fracture set parallels this structure.

The texture and color are somewhat varied; the rock is of medium grain with rare gneissic banding, pegmatite and narrow quartz veins. The color is mostly a pale- to medium-red and this shade was seen to extend to the "chopper pad".

Area "B": joints are in moderate abundance and the area is adjacent to other well-fractured areas. The rock is of medium grain and pale- to medium-red color. The potential is regarded as being low.

Area "C": the current assessment cannot be too critical as the area is 50 to 60 percent covered. Joint density is irregular and the outlined area (Fig. 2) includes some well-fractured sections. The rock is somewhat variable in character but it is typically of medium-grained texture and a good red color.

Area "D": critical assessment is presently difficult on account of almost 50 percent of the area being covered, however, sections of a relative massive nature

occur within this area of variable joint density. The rock is typically of medium-grain size and of a medium red color.

Conclusion: an overall rating of these 4 areas, from that of highest potential, would be - A, D, C and B. Areas A and D probably could be regarded as a single body; at present they are separated by a considerable amount of cover. In the event of a re-examination the A - D area would be the only section worthy of further study.

Site 15: two hours of evaluative geological work was carried out on site 15 before a total effort was concentrated on a much more promising area, site 16. Site 15 has about 25 feet of local relief and lies perhaps 45 feet above the surrounding plains level. It consists of a large main outcrop (400 x 300 feet) and an isolated eastern section 75 x 100 feet (Fig. 3). The eastern outcrop is separated from the main outcrop by a 15 foot wide section of amphibolite dykes and joints both trending parallel to the foliation in the red granite. A large extensively fractured area occurs just south of the eastern outcrop. The main outcrop has a fairly steep, irregular eastern face dipping at approximately 20 degrees eastwards whereas the western side slopes down at about 3 to 5 degrees. Two major faults trending approximately north 80 degrees east cut the main outcrop. These faults are generally well covered in valleys but show a blocky fracture in the adjacent wallrock. Both minor gneissosity and quartz veins in the main outcrop commonly subparallel the rock foliation.

Conclusion: from a very cursory examination, the eastern outcrop, due to its massive character and fewer observed geological defects, affords the best possibilities as an ornamental-buildingstone.

Site 16: five areas of relatively massive rock from an initial study of fracture density have been delineated (Fig. 4). At this early stage of examination there appears to be considerable uniformity in character of rock throughout the site which is described below.

Joints are mostly systematic and in the master and major categories; in different sections of the site the various joint directions may be alternately either master,

major or minor in significance. The three main joint directions are north 5 to 10 degrees west; north 75 to 85 degrees east, and north 50 to 60 degrees west. A north 5 to 10 degrees west system of master and major joints parallels a well-established series of faults, at least two of which have been intruded by basic dykes (Fig. 4). These two faults divide the site into three north-trending slices of rock referred to as the West Hill, East Hill, and East Shoulder. The flattish 10 to 11 degree south slope of the hill appears to be a fracture surface exposed in the course of glacial erosion. Parallel underlying fractures can be observed in scarp faces located at the north end of East Hill and in the sides of the gullies of the northerly trending faults.

There is limited variation of both texture and color in the rock. The average texture is of medium-grain size, with locally coarser grain and very minor, small diffuse-margined pegmatites, e.g., up to one foot in width and ten feet long. Quartz veins are short, (up to 1 foot long) and blue quartz veins have been noted parallel to and within fractures of all three major orientations. Limited gneissosity has been observed as indistinct narrow zones (2 feet ± wide) of mafic mineral bands, principally occurring in the central and western areas of the site.

Color variation is limited in the fresh unaltered rock, being of deep- to medium-red intensity. The deepest red so far encountered comes from areas C and the northern extremity of D.

Alteration which has resulted in local 'leaching' of the red granite is attributed to two causes:

(a) a zone of grey rock from 2 to 5 feet wide occurs on either side (but mostly on the east) of the two basic (amphibolitic) dyke intrusions. This anomalous grey grades to the typical red color over about a two foot wide zone. The color leached effect is attributed to contact metamorphism by the basic intrusions which may have been accompanied by hydrothermal action;

(b) uncommon discoloration of the outcrop surface away from the fault-intrusion zones is attributed to possible surficial effects due to deep weathering originating in the Tertiary Period.

Development of the three major joint systems at this site appear related to tectonic conditions rather than to decompressional strain release resulting from unloading, because:

(1) basic dykes have been intruded along faults which parallel one major joint system; and

(2) quartz veins have been intruded along all three principal directions of vertical to steeply-dipping fractures. Only the flatter 10 degree southward dipping fracture may be related to strain release due to the effect of unloading.

Conclusion: an overall rating of the five areas in sequence from the highest potential is — A, C, E, B and D. All five areas from this site are rated to be of higher potential than those described at sites 11 and 15.

Further detailed study with the continued elimination and better definition of preferred target areas should proceed entirely at site 16 in accordance with the exploration findings to date.

General Summary

Geological assessment of the Chipewyan red granite pluton has progressively reduced the size of the target area for increasingly detailed examination throughout the successive phases of exploration.

The general color and textural qualities encountered at site 16 are at least comparable to those revealed in the large cut and polished specimen obtained by the Research Council in September 1971, and which has been regarded as a reference standard for commercially acceptable material.

Site 16 is located 3000 feet from navigable water, 2 miles from the present tug and barge route of Northern Transportation Limited, and could be reached by a 6 mile road from the public airport, a total distance of 11 miles from Fort Chipewyan.

PRELIMINARY FIELD EXAMINATION REPORT ON THE QUARRY HILL SITE (SITE 16)

Stage 9 - Hydraulic Sluicing

Though a considerable proportion of the Quarry Hill site consists of granite outcrop, the textural detail of the rock surface is largely obscured by overgrowths of lichen and moss. The critical evaluation of rock for buildingstone purposes requires a close observation of rock color, texture, mineral banding, quartz veins, and fracture frequency and patterns as revealed in a clean and continuous outcrop surface. Consequently, some 75,000 square feet of outcrop were cleaned by hydraulic sluicing, using muskeg water pumped through 2,000 feet of 1 1/2 inch line laterally and lifted some 90 feet vertically. A second unit pumped water from a storage tank located on top of the hill to provide adequate water pressure at a 1/8 inch nozzle. As much organic cover as possible was shovelled and removed in the dry state and hydraulic water was only used to complete the final clean up of the outcrop surface. Working at 2 to 3 foot distances nozzle pressure was adequate to clean off the usually adherent lichen from the outcrop surface.

Glacially polished and smoothed outcrop surfaces provided suitable conditions for the evaluation and mapping of the various geologic features of concern in this study.

Geological Mapping

Location control for geological mapping was based on the grid lines (steel tape and compass) laid out in the earlier preliminary survey-evaluation, and extended by use of pace and compass. The geology of the significant parts of site 16 is

presented in a geological sketch map, figure 6, and the relevant features are noted – fracture frequency, shear-fractures, gneissic banding, quartz veins, pegmatites, faults, dykes and an outline of the hydraulically cleaned outcrop surfaces.

Evaluation from Geological Mapping

The Quarry Hill site is dissected by two principal series of almost perpendicular fault fractures, the north 10 degrees west series predominating (Fig. 6). A number of faults parallel the northerly trending fractures and two of the main faults divide the hill into three sections which have been designated – West Hill, East Hill and East Shoulder.

The major northerly trending faults form significant valleys, and although these valleys lack good exposure, basic dykes have been located along sections of three of the faults.

West Hill

The incidence of largely north-trending quartz veins, pegmatites, gneissic banding and a zone of grey rock eliminates a high proportion of the cleaned rock area of the West Hill, despite this rock having a relatively low fracture density. This is particularly unfortunate, for the southern section of the West Hill has both very widely spaced east-west fractures and displays some of the deepest, (richest) red color.

East Hill

Mapping has delineated two areas (Fig. 7) as potential quarry sites, although the upper (northern) section of the hill is by far the more outstanding prospect. An area of 100 x 50 feet holds considerable promise with respect to depth of color, uniformity of texture and the relative lack of quartz veins, gneissic banding and pegmatites. Extensions or nearby additions to the outlined area might be found northwards to the top of the hill, east, and south as far as the covered east-west fracture-valley which intersects the lower base line at +70 feet.

On the East Hill there are indications that other areas with few fractures could be classified as potential buildingstone material, but further clearing and sluicing would be needed for more critical evaluation.

East Shoulder

Due to both the lack of time and the good potential revealed in the upper East Hill area no clearing or sluicing of outcrop was undertaken on this section of site 16. Some fairly fracture-free areas with deep-red colored rock were noted in this section in the course of the initial preliminary survey (Fig. 4).

Geologic Features

The general geologic character of the hill site, as related to its ornamental-buildingstone potential, is described under the following headings.

Fracture Frequency and Distribution

Fracture frequency was judged qualitatively on the outcrop and divided into three categories:

- closely fractured (less than three feet apart in two directions);
- 70 percent of rock with fractures greater than three feet apart;
- fractures generally greater than six feet apart.

The last category (in association with a proportion of the middle category) is used as a guide to selecting areas of buildingstone potential.

The assessment of fracture incidence and their patterns of distribution can best, and in fact can only, be critically made in direct sunlight with the observer looking towards the sun. In this situation shadows which form in even the smallest fracture indentation can be readily seen by the observer. This particular point is most important in any critical evaluation of fractures in outcrop.

Most fractures are of the systematic variety and range from master to major to minor in importance. Many of the master joints are multiple fracture surfaces, have notable surface separations, and indications of shearing may be evident. Many major joints occur as single fracture surface breaks with no parallel shears along the margins. Both master and major joints and fractures are expected to penetrate many tens of feet in depth from the outcrop surface. Minor joints extend for several feet along the outcrop surface; they may parallel either the master or major joints, or trend in an entirely different orientation. These minor joints are expected to extend up to 10 feet or so in depth.

Some of the major joints make up sets of widely spaced fracture sheeting, oriented either parallel to the two established principal joint directions or they may trend in other directions (Fig. 6).

The detailed mapping of joint systems, orientations, frequency, etc., has not been undertaken at this time: it more appropriately belongs to the next scale of detailed geological mapping to be carried out in conjunction with a plane table survey.

Gneissic Banding

Diffuse-margined mafic mineral (chloritic biotite) banding, typically from less than one inch to two inches wide have been noted and are plotted on figure 6. These bands are usually grouped in zones a few inches in width and extend parallel to the rock foliation continuously for tens of feet.

Gneissic banding is a generally undesirable feature in an ornamental stone but the indicated frequency and distribution at the Quarry Hill site suggests that there are considerable large areas free from banding. Nowhere is gneissic banding of an intense nature in terms of color contrast between adjacent mafic and felsic bands. These bands are most commonly encountered in a northward trending zone in the central section of West Hill, but they can also be found at scattered places over the hillside. Clearing and sluicing to expose fresh, clean outcrop surfaces over large areas signifi-

cantly changed the impression and increased the accuracy in assessment of such factors as gneissic banding, pegmatites, rock color and quartz veins.

Rock Color Variation

Over the entire hillside, rock color ranges from deep-red to medium, light, and pink, and even grey phases are present. However, by far the greater amount of rock has been classified in the deep-red and medium-red categories. Variations in color do not appear to be effective over short distances and significant areas of the desirable deep-red rock have been outlined (Fig. 7). An arbitrary three-fold division of the red color variation has been made and applied to the classification of varnished, cut rock surfaces (Fig. 7). Some 125 hand specimens have been obtained from the site (56 by drill and blasting from the most promising areas of East Hill, and 69 surface samples from a general survey of all of site 16). Comparison of surface and nearby blasted samples may show slight color differences due to weathering, and hence greater reliability is placed on the fresher drilled and blasted samples. (One foot long holes were drilled at an angle of about 20 degrees from the ground surface to obtain the fresh rock samples.)

Local light grey color variations have been attributed to two possible factors:

(a) contact alteration effects adjacent to the basic dykes; and
(b) surface alteration due to deep weathering effects dating from the Tertiary Period.

Effects of the latter will diminish and ultimately disappear with depth, but whether or not any noticeable changes can be expected over normal depths of quarry operations (20 to 100 feet) is questionable.

Grain Size Variation

The usual coarse, medium and fine-grained classification (>5, 5 to 1, and <1 mms) has been applied to 125 hand specimens and the results are summarized on figure 7.

The majority of the rock is medium grained, consequently only coarse- and fine-grained variations are recorded below the sample locations given on figure 7.

Foliation

Foliation is rarely a prominent feature of the red granite in so far as the rock is typically mafic poor. The rock characteristically has about one percent mafic mineral present which is dispersed rather than concentrated into streaks, bands or lenses which would provide a more distinctive foliation. The texture tends to be massive to very poorly foliated; in the latter case quartz may show preferred alignment of mildly elongated grains parallel to aligned (chloritic) biotite.

Mafic Mineral Variations

The mafic mineral content has a total range (in hand specimen) from zero to between 5 and 10 percent but the typical concentration is in the 1 percent range.

The development of gneissic banding is associated with relatively mafic-rich portions of the outcrop.

Pegmatites

The incidence of pegmatites in the outcrop is relatively low. Those pegmatites exposed are typically fairly straight dykes over lengths from 25 to 100 feet and of uniform widths from 4 to 8 inches thick. There is a virtual absence of minor pegmatite bodies (patches, pods or lenses) and those mapped on figure 7 can be taken to be an accurate indication of the frequency and distribution of pegmatites. The pegmatites are of uniform granitic composition, being either mafic poor or even lacking in mafic minerals completely. Pegmatite dykes appear only in part to be structurally related to either the foliation or the principal faults.

Quartz Veins

Quartz veins are commonly 1/2 to 1 1/2 feet long and from 1/2 to 2 inches thick, having a maximum of 9 inches thick. They are composed of quartz with essentially no other mineralization. The orientation of quartz veins is controlled by the two principal shear-fracture directions with the northerly direction being most common.

Basic Dykes

Narrow, straight, amphibolitic dykes have intruded at least three of the principal north 10 degrees west shear-fault structures at the Quarry Hill site. These dykes are generally from a few inches to two feet thick and have been seen to be continuous for up to 30 feet along strike, though they are poorly exposed in the vegetated fault gullies and are expected to extend continuously for much greater distances along strike. Fault movement is evident during post-intrusion times as the dyke material is typically sheared and locally shows a megascopic shear foliation.

Drastic color alteration has taken place in the red granite adjacent to some of the principal north 10 degrees west faults. Grey granite zones extend up to 25 feet away from the central shears and have been mapped for strike lengths of over 200 feet. Some sections of observed dyke appear not to have an adjacent grey granite alteration zone, and furthermore, some shear-fault zones appear to have a grey alteration zone but lack a dyke intrusion. Consequently, the grey alteration zone appears most likely related to fault-controlled hydrothermal alteration rather than to dyke intrusion specifically — though a genetic connection between the alteration and intrusion may well be anticipated.

Pyrite

One of the most undesirable features of a potential ornamental-buildingstone is the presence of pyrite because of the rust stain that develops upon weathering. From megascopic examination the red granite essentially lacks pyrite — this iron sulphide was seen at only one location, in minor amounts, in a quartz vein association at test block site III, in the lower West Hill section.

Conclusions and Summary

1. Hydraulic sluicing and cleaning of a high proportion of the hillside has provided the means for a very critical evaluation, revealing all geologic defects of this potential ornamental-buildingstone which may be evident in outcrop.

2. Consideration of fracture spacing, rock color and texture indicates an area about 50 x 100 feet (Fig. 7) on the Upper East Hill suitable for further exploration.

3. Fresh samples obtained by drilling and blasting provide the most reliable guide to rock color. The uniformity and depth of color appear favorable as a guide to a potential ornamental-buildingstone.

4. The hill has a total relief of over 80 feet above the surrounding plain, and the relief within the main area outlined as a potential buildingstone (Fig. 7) amounts to some 20 feet. In other words, the terrain situation would lend itself to a side-hill quarry operation, the simplest and least expensive mining method.

Recommendations

Sufficient geological data has been gathered on the ground in this initial exploration phase to justify a serious and complete economic-market study to examine the feasibility of establishing ornamental-buildingstone quarry and dressing plant operations. The exploration remaining to be carried out at the study site would involve a diamond drill core operation to establish the quality and continuity of rock at depth and to build up a suitable (10 year) reserve of quarriable material.

APPENDIX

Notes on Outcrop and Hand Specimen Evaluation Procedures

An exploration evaluation procedure for a potential ornamental-building granite stone has been broken down into a specific sequence of steps, namely:-

(1) fracture character study from the air and then in outcrop;

(2) rock type imperfections, mixtures and discontinuities in the outcrop; e.g., quartz veins, pegmatites and gneissic banding;

(3) uniformity of texture in outcrop and in rough-faced hand specimens; and

(4) shade and uniformity of color and textural quality in cut, varnished hand specimens.

The ornamental-buildingstone industry requires finished rock slabs of a substantial minimum size, hence a minimum outcrop fracture spacing of about three feet has been established as a desirable standard requirement over areas greater than 50 x 50 feet to generally merit a continued exploration effort.

Structural features such as quartz veins, pegmatites and gneissic banding, which may not be pleasing to the geologically oriented individual, are totally unacceptable in the traditional ornamental-buildingstone trade. Uniformity of both texture and color are most desirable features in this application, even to the point where a massive texture is preferable over a mildly foliated one.

The shade and uniformity of color, along with textural uniformity, are of prime importance and are largely responsible for the esthetic quality achieved in an ornamental stone. These factors can be best assessed in a flat polished surface, however, for convenience, cost and speed, a very good approximation can be obtained by coating the cut surface of a hand specimen with a film of clear shellac or varnish. A portable rock-cutting 14 inch diameter circular saw was used for this purpose in the field.

Cut rock surfaces larger than hand specimens are needed in order for architects to assess the esthetic quality of a rock. For this purpose five large blocks from 2 to 3 cubic feet in size have been mined from different parts of the site and shipped to Edmonton for dressing and examination.

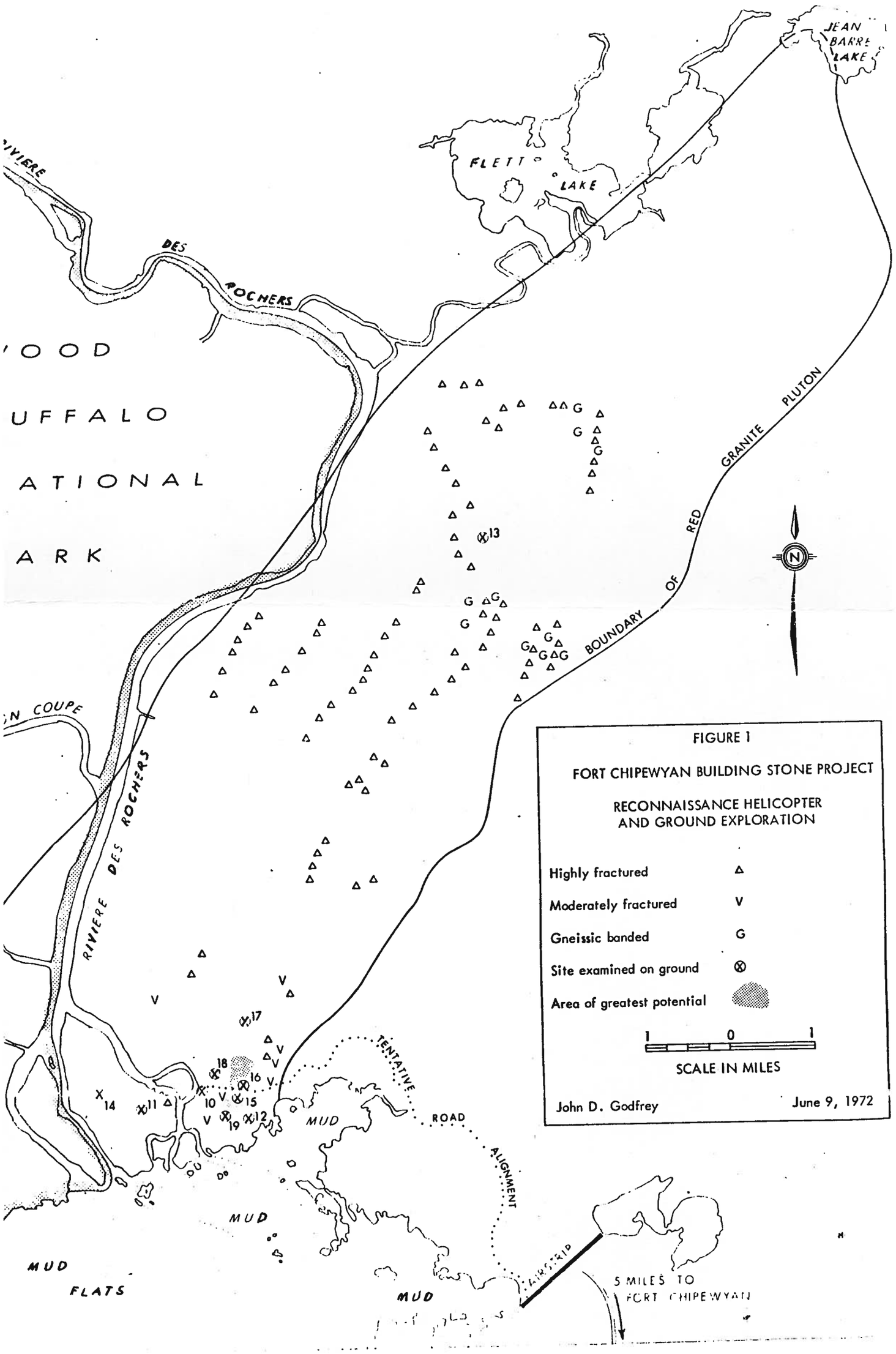

JEAN BARRE LAKE
FLETT LAKE
DES ROCHERS
RIVIERE
OOD
UFFALO
ATIONAL
ARK
BOUNDARY OF RED GRANITE PLUTON
N COUPE
RIVIERE DES ROCHERS
TENTATIVE ROAD ALIGNMENT
MUD
MUD
MUD
MUD
FLATS
AIRSTRIP
5 MILES TO FORT CHIPEWYAN
N
FIGURE 1
FORT CHIPEWYAN BUILDING STONE PROJECT
RECONNAISSANCE HELICOPTER AND GROUND EXPLORATION
Highly fractured △
Moderately fractured V
Gneissic banded G
Site examined on ground ⊗
Area of greatest potential
1 0 1
SCALE IN MILES
John D. Godfrey
June 9, 1972

FIGURE 2

FORT CHIPEWYAN BUILDING STONE PROJECT

PRELIMINARY GEOLOGICAL SKETCHMAP
AND SAMPLE PLOT AT SITE #11

Hand specimen ×11-9

Fractures

Scarp (height in feet) 10'-15'

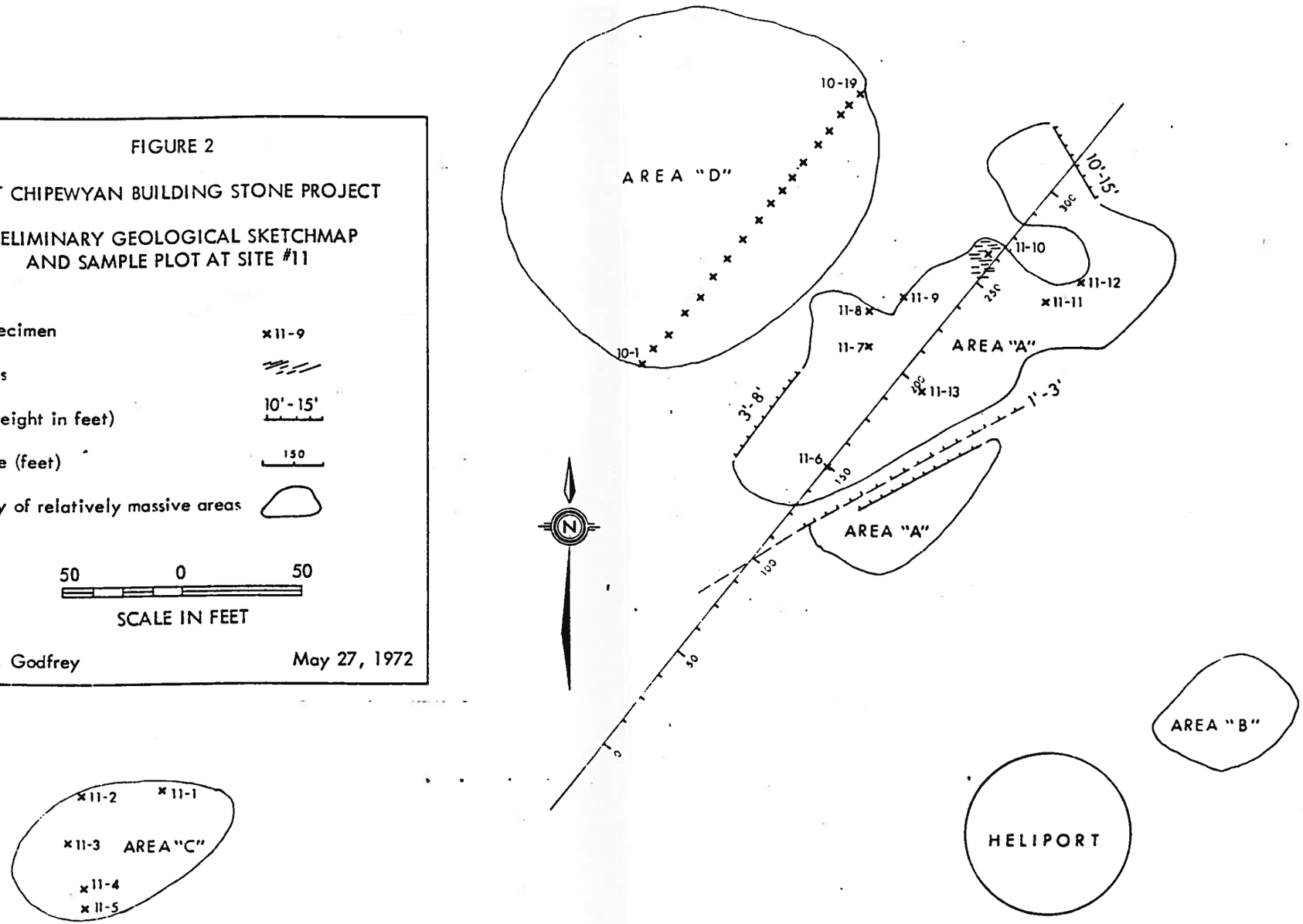
Base line (feet) 150

Boundary of relatively massive areas

50 0 50

SCALE IN FEET

John D. Godfrey May 27, 1972



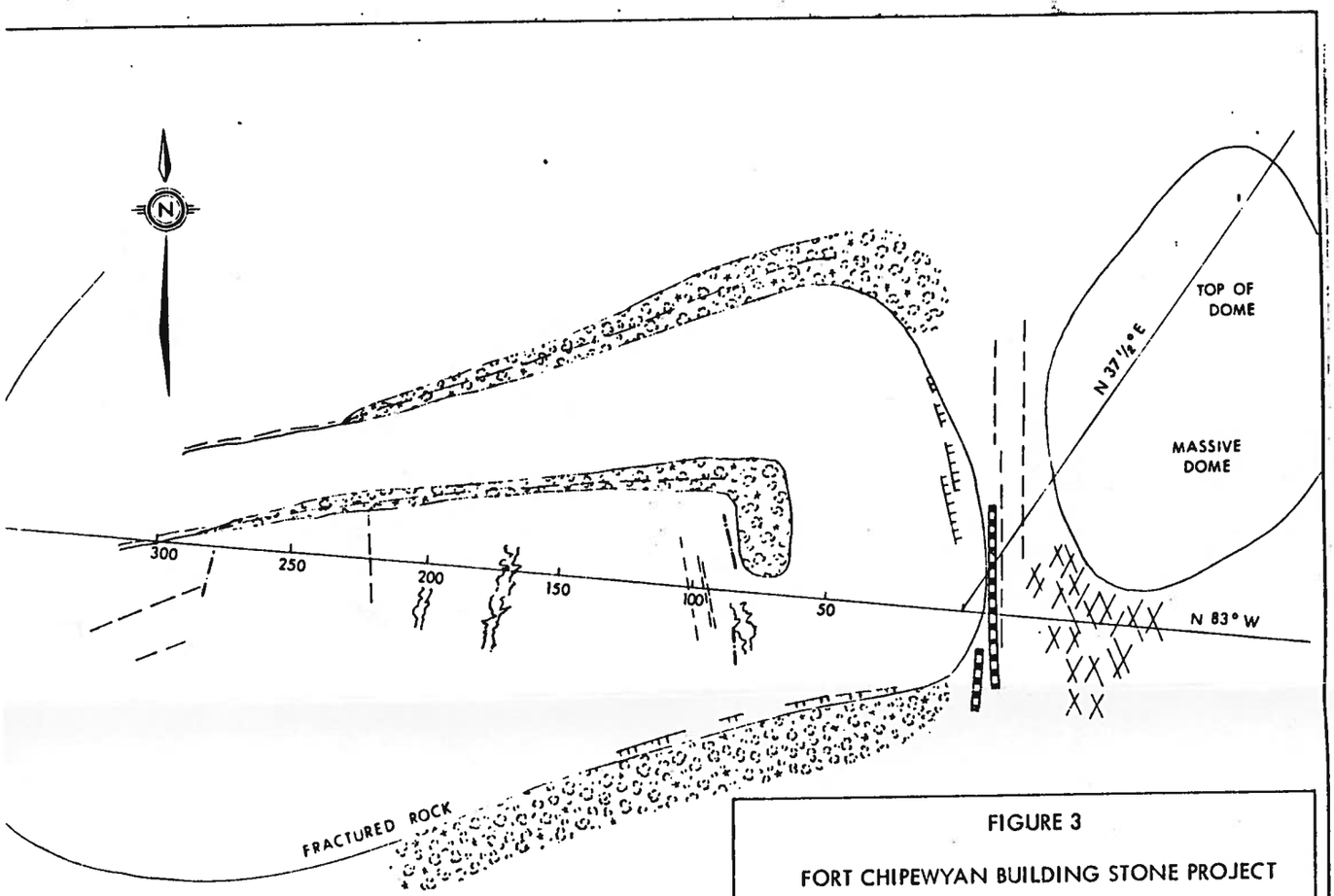


FIGURE 3

FORT CHIPEWYAN BUILDING STONE PROJECT

PRELIMINARY GEOLOGICAL SKETCHMAP AT SITE #15

Quartz veins

Fractures

Basic dyke

Gneissosity

Outcrop boundary

Base line (feet) 250

Scarp

Covered area

50 0 50

SCALE IN FEET

M.B. Dusseault

May 28, 1972

FIGURE 4

FORT CHIPEWYAN BUILDING STONE PROJECT

PRELIMINARY GEOLOGICAL SKETCHMAP AT SITE #16

Fractures

Basic dyke

Gneissosity

Relatively massive area

Fault (dip shown)

Scarp

Covered area

50 0 50

SCALE IN FEET

John D. Godfrey June 9, 1972

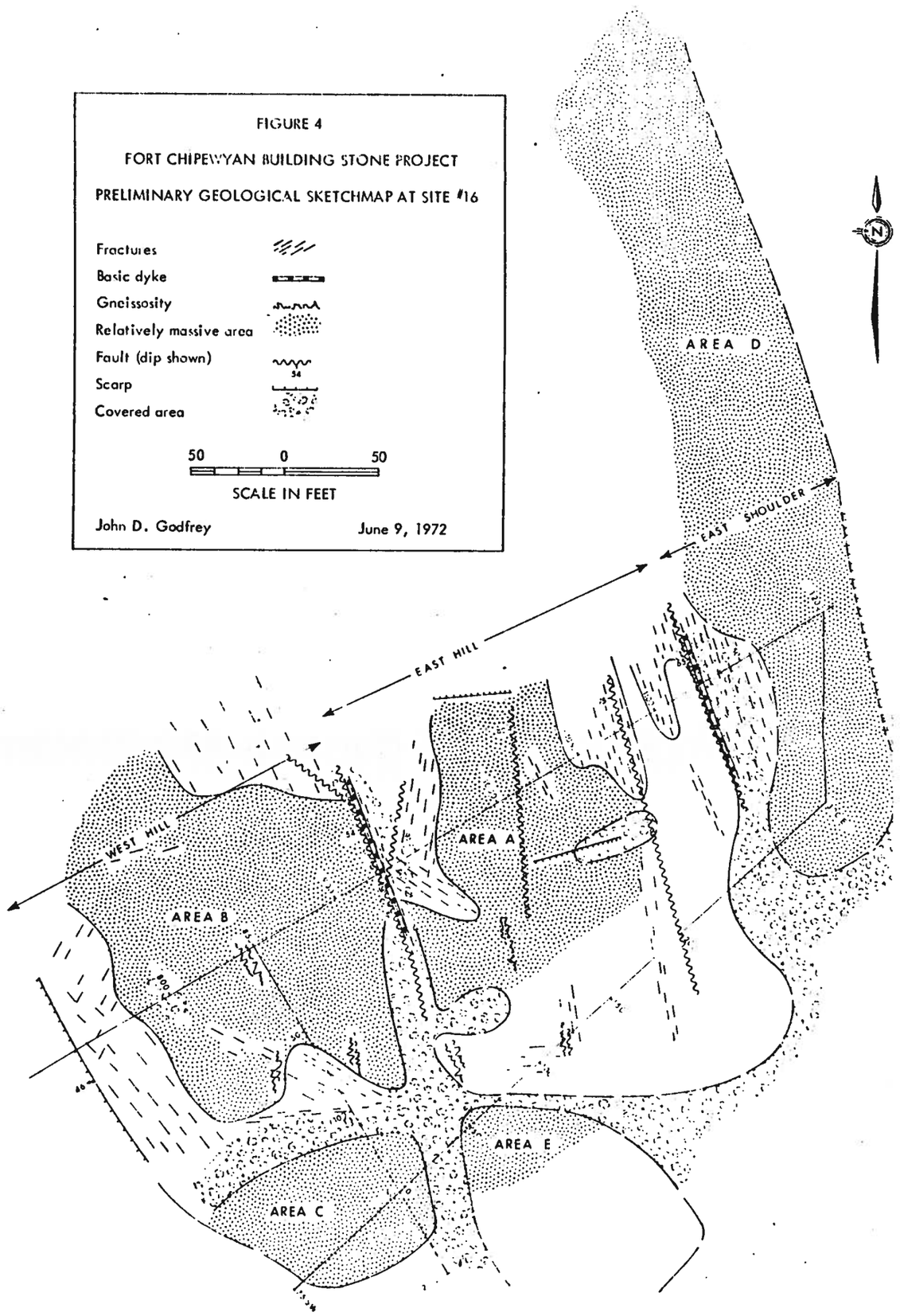


FIGURE 5

FORT CHIPEWYAN BUILDING STONE PROJECT

GENERAL SAMPLE PLOT

QUARRY HILL (SITE #16)

Hand specimen ×17-3

Test block site II

Base line (feet) 5S

50 0 50

SCALE IN FEET

John D. Godfrey June 27, 1972

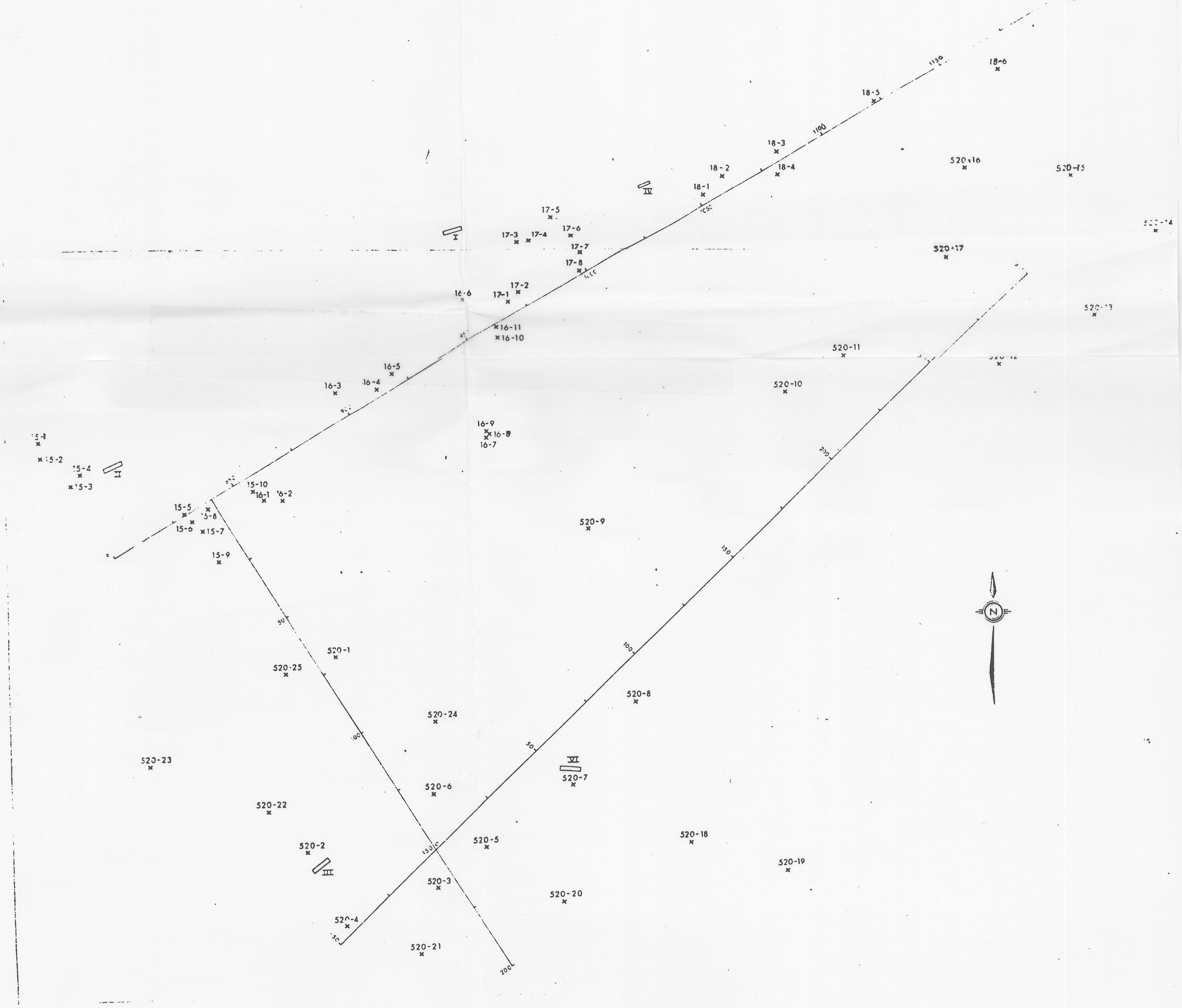


FIGURE 6

FORT CHIPEWYAN BUILDING STONE PROJECT

GEOLOGY AND BUILDING STONE POTENTIAL

QUARRY HILL (SITE #16)

Fracture density
- Closely fractured ..... p
- 70% with fractures > 3 ft. apart ..... g
- Fractures generally > 6 ft. apart ..... e

Principal fracture trend .....

Fault .....

Gneissic banding .....

Quartz veins .....

Pegmatite .....

Grey rock ..... R

Basic dyke .....

Steep slope .....

Scarp .....

Covered area .....

Relative elevation (feet) .....

Base line (feet) 250

Test block site II

Geologic detail undetermined ..... ?

25 0 25

SCALE IN FEET

John D. Godfrey June 29, 1972

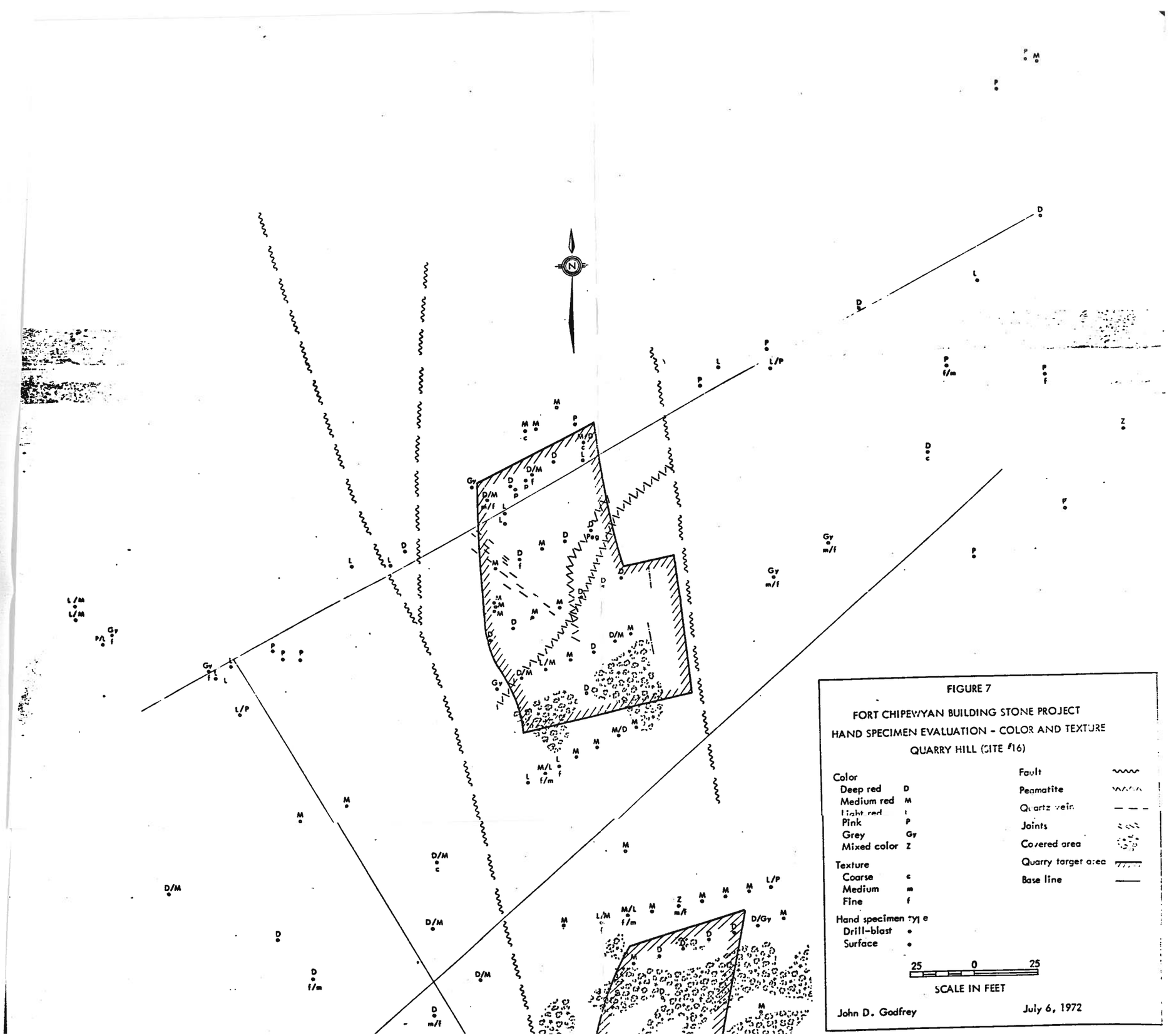


FIGURE 7
FORT CHIPEWYAN BUILDING STONE PROJECT
HAND SPECIMEN EVALUATION - COLOR AND TEXTURE
QUARRY HILL (SITE #16)
Color
Deep red D
Medium red M
Light red L
Pink P
Grey Gy
Mixed color Z
Texture
Coarse c
Medium m
Fine f
Hand specimen type
Drill-blast •
Surface •
Fault
Pegmatite
Quartz vein
Joints
Covered area
Quarry target area
Base line
25 0 25
SCALE IN FEET
John D. Godfrey
July 6, 1972