

**Golder Associates**

CONSULTING GEOTECHNICAL AND MINING ENGINEERS

REPORT TO
KNOX MARTIN KRETCH LTD.
ON

TOWN OF COBALT
MINING HAZARD ASSESSMENT
PHASE IV A
COBALT ONTARIO

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EXECUTIVE SUMMARY

A review has been undertaken of available mining records covering the Town of Cobalt outside the areas designated by Cunningham (1981) as for "mining use only". These have been assessed together with the data from the previous investigations carried out for the Highway 11B corridor.

No additional hazard sites have been disclosed that had not been previously recognized either by the 1981 Cunningham report or by the 1985 Golder Associates report.

Four hazard locations, outside the highway corridor have been delineated for further investigation:

- the Galena Street/Grandview Avenue Corner Area,
- the area between Coniagas Road and Prospect Avenue,
- the area generally south of the intersection of Galena Street and Miller Avenue, and
- the section of the Ontario Northland Railway land, east of the Rugged Chute Road Bridge.

For each of these areas an appropriate follow-up (Stage IVB) investigation has been recommended.

In addition, an area east of Coleman Rd., although already in part designated as for "mining use only" requires further examination in order to select the route for a proposed watermain connection between the Contract 4 and Contract 5 areas.

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1. INTRODUCTION

Golder Associates was retained, in January 1988, by Knox, Martin, Kretch Ltd., on behalf of the Ministry of the Environment to carry out an appraisal of potential mining hazard sites within the Town of Cobalt, but outside the Highway 11B Corridor and specifically concentrating on factors that could influence construction of the proposed watermain system (Figure 1). (Potential Mining hazards within the Highway 11B Right of Way have not been further examined in this report as they have already been addressed in previous reports - Phases I, II and III - refer to Golder Associates reports #871-1289 dated August 1987 and #871-1289-1 dated October 1987, #871-1347 dated October 1987, #871-1347-1 dated January 1988 and #871-1447 also dated January 1988).

The scope of the current appraisal and possible follow-up investigations were outlined to a meeting of the Inter-Ministry Steering Committee on Cobalt Hazards held on 5th November, 1987, and described in Golder Associates letter dated November 12, 1987; approval to conduct the review being received in mid-January 1988.

A previous study, carried out by Cunningham and Associates, in 1981, recommended that certain areas of "high risk" within the Town be designated "for mining use only" (see Figure 2 and Golder Associates reports #851-1172 dated October 1985 and #861-1255 dated March 1987). Review of these high risk areas has not been included within this report except where a public road (Coniagas Rd.) crosses one such area in the north central section of the Town, and where sewer or watermain connections across such areas have been proposed by Knox, Martin, Kretch Ltd.

The 1981 Cunningham study also recommended other areas for 'caution', and specifically recommended further investigation or remedial measures, including concrete capping, fencing and/or filling at specific locations.

This current report re-examines available data including:

- the composite plans and documentation within the Cunningham (1981) report,
- mining plans, sections and compiled documents held by Agnico Eagle Mines Ltd. and by Canadaka Mines Ltd. relating to work on all of the properties within the Town area,
- the 1922 detailed geological reports on the Cobalt Mining Camp and the 1950's Thompson compilation maps for the properties,
- selected Ontario Department of Mines Annual Reports for the period of the lessors (ie. the 1930's and 1940's), and
- selected magazines, books and newspaper articles from the Cobalt Nugget and from other sources held in the Cobalt Mining Museum relating to the early mining years.

In addition, information on occurrences of frequent road repairs, on fractures of water services and on reported incidences of ground subsidence in the Town have been compared with the available data to delineate areas of concern not previously recorded.

This current report, therefore, forms an extension to the 1981 Cunningham study and to an assessment carried out by Golder Associates in 1985 for the proposed watermain and

sewer upgrading for the Town, (Refer to Golder Associates reports #851-1172 and #861-1255).

Because of the impending watermain and sewer improvement project to be undertaken by the Town, specific reference is made within this report to the proposed contract areas. Our previous study, having addressed the area in general, concluded that major hazardous mining workings are unlikely to be present crossing the proposed route alignments for the services to be installed in the areas of Contracts 1, 2, 3 or 4 (see Figure 1); however, considerable concern was expressed regarding indiscriminate blasting and the use of conventional sewer trench construction techniques through the area of Contract 5. Further, in view of the numerous incidences of surface subsidences and cave-ins particularly in and around the Contract Area 5 within the Town of Cobalt, Golder Associates was requested in this present study to evaluate all of the present Municipal area not within the Highway Corridor strip examined in the 1987 Phases I, II and III investigations and not within the area already excluded as for "mining use only".

On this basis, several areas of concern have been identified and recommendations have been provided for preliminary field examination or for detailed follow-up investigations. Timing for Phase IVB, the follow-up investigations, will need to be optimized not only to take into account the degree of hazard identified in Stage A (as discussed in this current report) but also to coordinate with the scheduling of contracts for the proposed watermain and sewer installation programme.

Where hazard delineation is still unclear after completion of the Stage B evaluation or where more information is required for design of remedial measures, further detailed drilling will be required.

2. BACKGROUND

Discussion of the mining practises and of the state of the available records on the excavations that exist beneath the Town of Cobalt has been previously reviewed in Golder Associates report #851-1172, dated October 1985.

Information on the mining activities that took place beneath the streets and properties in the area of the Town of Cobalt is incomplete. Most of the stoping plans and sections for the mining workings no longer exist. The records that do remain have been fortuitously preserved only by the diligent efforts of companies like Agnico Eagle Mines Limited who have carefully collected, compiled and indexed any old drawings that they have come across.

We understand that, in the thirties, many old mining plans and even the empty headframes and old surface buildings in which they were stored were destroyed. Fortunately, much documentation still exists; however, it is apparent that a considerable quantity of valuable records were destroyed or never existed. Certainly, based on the information gleaned from discussion with Senior Mining Engineers, familiar with the Town, extensive mining excavation work was carried out for which no records exist.

This lack of records not only applies to the undocumented work undertaken in the 1930's and 1940's by the lessors (refer Golder Associates Reports #851-1172 dated October 1985 and #861-1255 dated March 1987), but also applies to excavations undertaken by the earlier major mining companies for which the records have been lost.

Practises by the early major companies were not altogether without criticism - Baldwin, writing in his 1978 paper on "The Development of an Unplanned Community - Cobalt 1903-1914" states that mining operations were a constant form of annoyance to the Town's citizens, citing the example of the arrest of officials of the Coniagas Mining Company because they would not stop exploration trenching along Prospect Avenue. In fact, this incident in 1907 sparked off a two year legal battle between the Town and the Mining Company to establish who had surface rights to the ground.

Review of the extensive collection of old photographs in the Mining Museum, which depict old Cobalt during the mining heyday, reveals that the Town was completely disfigured by waste dumps and ore piles, set within the maze of headframes and tar-paper shacks in which the majority of the population lived. Examination of the earliest available aerial photographs for the Town (1938 and 1948) also show the considerable influence of mine waste on the topography and character of the Town area.

This profusion of waste dumps and of mining infrastructure (tailings pipelines, ore conveyors and other structures) set amid the Town streets has so significantly altered the natural topography that it is almost impossible now to ascertain from the present topography the presence of many of the old surface shallow open cuts or mine workings that broke through to surface. In consequence, reliance has to be placed on available documentation and on hearsay information for locating significant areas of mining exploitation.

3. HAZARD AREAS

The first serious attempt to document the location of hazardous near surface mining workings in the Cobalt area was completed in 1981 by Cunningham and Associates. Several 1:2000 overlay plans were prepared, documenting known, near surface workings. Figure 2 presents a composite of these plans for the upper level workings superimposed onto the topographic plan of the Town in order that the locations of the subsurface workings can be readily identified with respect to visible surface features.

On the basis of the information presented on Figure 2, on that contained in the Cunningham study, on further examination of the mining records and on an investigation programme carried out for the water and sewer improvement project, an overall hazard map for the Town was produced in 1985 by Golder Associates. This drawing, which has undergone several updates and revisions and which is presented as Figure 3, has formed the basic targetting plan for previous studies, including identifying and characterizing hazards that might affect the proposed watermain or sewer contracts or could give cause for concern to Highway 11B through the Town.

All of the principal mining property boundaries and the majority of the major mining veins are shown on Figure 3 together with the locations of all major hazard zones and geophysical anomaly targets identified by past studies. One of the most critical hazard areas of the Town occurs in the vicinity of the Townsite/City of Cobalt Mine boundary area, adjacent and around the Miller Avenue/Galena Street intersection. This area has recently been extensively investigated and remedial actions proposed for the identified hazards within the area (refer Golder Associates' reports #871-1347-1 and #871-1445).

As a result of the current studies presented in this report, four other principal hazard areas have been identified to exist within the Municipality, but outside the Highway Right of Way Corridor through the Town, and outside the areas designated by Cunningham(1981) as for "mining use only". These hazard areas are, in order of seriousness, as follows:

- AREA A - the Galena Street / Grandview Avenue intersection area, in the vicinity of the old Nancy Helens Mine and Buffalo Mine Property boundary;
- AREA B - the area north of Prospect Avenue to Coniagas Road where a complex of veins cross the old Coniagas Mining area (NB - this area includes an area previously recommended by Cunningham and Associates for "mining use only");
- AREA C - the southern section of Galena Street and the land under several of the properties west of and along Helen Street, south of the Highway 11B corridor on the old City of Cobalt and Townsite Mining properties; and
- AREA D - the section of the Ontario Northland Railway land, east of the Rugged Chute Road Bridge, along the old "Right of Way North Mine" workings, bordering onto the LaRose property.

Each of these areas is discussed in detail below, and for reference a composite index plan, presented as Figure 4 has been prepared to illustrate the location of the detailed plans prepared for each of these hazard areas.

3.1 Hazard Area A

The area of Galena Street previously mined by the Nancy Helens Mining Company was extensively re-worked in the 1930's and 1940's by the lessors.

Very little information is available on the geometry of the underground workings which currently exist beneath the Street or under the houses in the immediate area. However, as shown on Figure 5, several zones of stoping are known to extend across Galena Street and under some of the adjacent properties. Furthermore, as indicated in the records collected from Agnico Eagle Mines Limited, two areas of the old workings have, in the past, caved through to surface - one directly beneath the roadway and another (related to the old mine shaft) into the back garden of the property at #56 Galena Street. Cunningham in his 1981 report indicates that the section of the roadway in this area was capped in 1980, (see Figure 18 of Golder Associates report #851-1172 for details of capping). The precise date of the capping of the old stoped out shaft area (Figure 17 of report #851-1172) is unknown, but presumed to be in the early 1970's.

3.2 Hazard Area B

Mining exploitation on the Coniagas property beneath and adjacent to Coniagas Road, north of the Public School has been more or less continuous since the original discovery of silver in the early 1900's. Mining of the adjacent open cuts north of the road has continued to the present day under Agnico Eagle Mines Limited control. However, no work is known to have been done beneath the roadway area since the era of the lessors.

Apart from one plan, we have been unable to obtain any data on the work carried out by the lessors.

The one lessors' era plan (by Murphy and Landry - the lessors of the property during the thirties and forties) was found during recent searches of Agnico Eagle Mines Limited's records. This shows previously unrecorded open cut development from surface and some stoping from the 150 ft. level, but no details of the geometry of the lessors' workings were found. However, the very existence of this drawing could be inferred as an indication of the lessors' intention to continue mining of the veins in the area.

Although all the publicly accessible surface open cuts have been fenced, the fact that at least two incidences of ground subsidence have been documented in the area outside those sections that have been fenced, gives rise to concern regarding stoping that may have been carried out, either by the original mining company prior to the 1920's, or by the lessors. One of the areas which is reported to have caved through to surface occurred beneath the driveway of the house on the corner of Cobalt Street and Coniagas Road. Based on the information obtained from the drift plans (Figure 6), it is considered that this cave-in likely was associated with stope development on the #9 Vein.

The other cave-in, which was recorded on a plan acquired from H. Sutcliffe Ltd., occurred in September 1973 adjacent to House #76, Chambers Avenue (see Figure 6). Capping details for this cave-in, which was thought to be associated with a raise, are shown on Figure 20 of Golder Associates report #851-1172.

Further to the south of these areas, other mining workings are known to exist (Figure 2). The Coniagas #6 Shaft, for instance, is known to be located directly under the Cobalt Public School. Information on the mining that was undertaken on the Coniagas property

underneath the area now occupied by the Public School is limited. The information that is available has been compiled onto Figures 7 and 8 , the latter of which is a 1" to 20' scale plan showing the School as-existing, including the addition completed in 1975. The plan has been overlaid with a grid of soundings carried out in 1956 prior to original construction of the classroom section of the school. It is understood that these soundings were carried out at the direction of the Architect to establish bedrock depths around the location of the Coniagas #6 shaft.

This shaft, which is shown directly under the school building is reported by Cunningham (1981) to have been filled with mine waste rock. The information on Figure 8 however, suggests that the shaft at least in 1956, was open to 53 ft. depth, but that it was concrete capped. Further, the cross section shown on Figure 9 (a 1916 drawing, obtained from Agnico Eagle Mines Limited records), suggests that the shaft had been at least partially stoped out and that the Vein #16 stope extends close to surface both to the west and to the east from the shaft under the school building and adjacent school-yard.

Further to the north, also under the school area, a second stope is shown on the 1942 lessors drawing to occur on Vein #15 (see Figure 7). Details on the 1916 sections shown on Figure 9 suggests that stoping may well also extend close to surface on this vein. The fact that the above mentioned lessor era drawing by Murphy and Landry shows these stopes with slightly more extensive mining development than 1920 drawings of the same area, raises questions regarding the present geometry of these stopes and of any crown pillar remaining over the stopes under the school or schoolyard.

In consequence, attempts were made to collect any available data regarding rock conditions in the crown pillars of these stopes or indeed on any site investigations for the school. No information other than the sounding information shown on Figure 8 is apparently available. In addition, discussions with representatives of the Timiskaming School Board and with the two architectural firms that were involved with the construction of the school have not shed much additional light on the pre-1956 investigations. However, attempts are being made by the School Board to find out if any additional information exists other than that shown on Figure 8.

3.3 Hazard Area C

The City of Cobalt Mine property and the adjacent Townsite Mine property were formerly operated by the Mining Corporation of Canada prior to leasing by Mr. A. Brocklebank in the 1930's and 1940's. During both the pre-lessor period and subsequently, because the ground was very rich in silver, much of the area under and east of the southern section of Galena Street was extensively stoped.

Robbing of crown pillars and extension of pre-existing stopes was the common practice of the lessors. This is typified in a 1939 Ontario Department of Mines report which, referring to the ground in and around Hazard Area C, states that "No underground development work was done. Ore was obtained from remnants of pillars and from old stopes."

Unfortunately, although hearsay information suggests that stoping was undertaken underneath the houses adjacent to Helen Street, south of Miller Avenue, little information exists on the geometry of stoping other than that documented by H.A. Kenty in 1946, whilst attempts were

being made to dewater the workings in this south-western corner of the Town of Cobalt. The information that is available is, however, summarized on Figures 10 and 11.

Other information, from local residents, suggests that areas of subsidence and "rat-holes" have from time to time appeared in the yard areas around some of the houses adjacent to Miller Avenue, notably south of and adjacent to House #28 Miller Avenue. Further, discussions with local mining engineers have indicated that stoping during the lessor period was brought close to surface under some parts of the area south of Miller Avenue.

Some of the documented workings within the highway corridor and adjacent to the Senior Citizens' Home, in the area around the City Mine Shaft were investigated as part of the Phase I and II Highway drilling investigations. The drilling programme indicated that the mine records, although broadly representative, are seldom accurate in detail.

Figure 10, which was compiled for targetting the investigation work under Highway 11B shows the configuration of drifts and workings known to exist in the area immediately around Miller Avenue. Some stoping is understood to have been carried out north of the road under private property adjacent to the Senior Citizens' Building on City Vein #3 and drift extensions from the City Shaft. Other workings were carried out south of the road around some of these areas as shown on Figure 10, while Figure 11 shows the documented upper level workings in the area to the south of that shown on Figure 10, extending to the shores of Cobalt Lake. The main zones of stoping to the south of Miller Avenue which are understood to have been undertaken by the lessors by gaining access to the underground via the #7 Townsite Shaft, appear to have been on the 'C' Vein, concentrated around the area of House #16

Galena Street and on the City of Cobalt property beneath the houses separating Helen Street from Galena Street. Unfortunately, no data exists on the geometry of the stoping carried out in this latter area. Figure 12 however, gives some indication of the known geometry of at least the early stage of stoping on the 'C' Vein on the Townsite side of the mining property boundary. As can be readily appreciated from comparison of Figure 12 with the newer planimetric data on Figure 10, a considerable amount of additional extraction apparently was carried out subsequent to the drafting of the stope section shown on Figure 12.

Information from the 1978 Knox, Martin, Kretch inspections of the sewer lines through Hazard Area C provides further information on ground conditions. Considerable distress is reported to the sewer system, mostly in the form of displaced and cracked pipes. Further, it may be significant that inspection of the lines along Helen Street was not possible due to obstructions and distortion of the pipe system.

3.4 Hazard Area D

The area underlying the present alignment of the railway tracks to the north east of the Ragged Chute Road Bridge was heavily mined on the LaRose and Right of Way North Mine properties. Mineralization, and hence most of the stoping, was predominantly focussed on the south and east side of the Cobalt Lake Fault (see Figure 3). Information from various sources suggests that stoping in this area came close to surface along the fault (ie., in the area directly under the railway lines). In fact, it is reported that during the 1960's period when attempts were being made to drain Cobalt Lake a deliberate breakthrough to the lake was created at the south-west end of the Right of Way North Mine Property on the boundary with the property of the Cobalt Lake Mine (see Figure 13).

Unfortunately, no records have been found illustrating the geometry of this breakthrough area. The locations of the two shafts that were put down on the Right of Way to gain access to the mineralization along the fault and the geometry of the known upper level drifts are however shown on Figure 13. Again, detailed information on the geometry of the stoping undertaken from these drifts has not been found, nor has any information been located on the depth of overburden and tailings/waste rock infilling the natural valley formed along the trend of the Cobalt Lake Fault.

4. ADDITIONAL STUDY AREA INFLUENCING WATERMAIN AND
SEWER CONTRACTS

As it is understood that routing for one of the new watermains will be required across the area east of Coleman Rd., between Highway 11B and Cobalt Lake to tie in the Contract 4 area with the old (existing) water system within the Contract 5 area (Figure 1), this area has been included in the current assessment even though the area is not designated as a hazard within the context of this report. This area, which is shown on Figure 11 is not normally accessed by the general populace. It, however contains numerous near surface workings, mostly on the Townsite and Townsite Extension properties.

Most of the critical zones of open stoping within the area have already been fenced, but, as also shown on Figure 11, numerous cross cuts and exploration drifts also exist. Published data suggests that little exploitable ore was found underneath the old mill complex north of the X-vein stope workings on the Townsite property (Figure 14), south of the S-Vein stope (ie. the stope that came to surface right under Highway 11B (refer reports #871-1289 and 871-1289-1). Extensive workings were however completed in the boundary areas between the Townsite Extension and the Right of Way south, Cobalt Lake and McKinley Darragh properties (see Figures 2 and 3). Several major veins were encountered. Some were mined from surface, by open cut. Some were developed from underground by stoping. Several shafts were sunk and numerous raises were developed, some right up to the bed of Cobalt lake.

5. INFORMATION GAPS

The data that has been accessible from the mining records for most of the area under examination in this present report gives details only of the location of the drifts that were developed from the main shafts put down by the original mining companies. A large part of the original information relating to stoping areas and to areas subject to exploration by the original companies has either been lost or never existed. Further, there is little documented information on anything done by the lessors. However, as witnessed by the remedial work that has already been completed under Highway 11B in front of the Furniture Store and the problems identified in the Miller Avenue/Galena Street intersection area, the actions of the lessors' have caused considerable problems to the Town. It should be realized, therefore, that the hazard areas identified in this report are prioritised on the basis of hearsay information, albeit from experienced mining personnel.

Whatever documentation has been found, has been closely examined to gain as much detailed knowledge as possible of the geometry of the workings in these identified hazard areas. Further hazards may well exist at other locations for which there is no available data or for which no-one has heard any rumours or remembers anything relating to hazardous old workings. It must be appreciated therefore, that even with delineation of the hazards outlined in this report by means of investigations in the manner recommended; contingency plans, specifically to cope with unforeseen conditions as a result of old mine workings, must still be incorporated into the Contracts for the watermain and sewer construction and for upgrading the Highway.

6. RECOMMENDATIONS

Although much fencing and capping work has been carried out over the last three years in the area around Cobalt under the jurisdiction of the Ministry of Labour and Ministry of Northern Development and Mines, action on many of the recommendations set out in the 1981 Cunningham report remain outstanding. All of the recommendations regarding capping and fencing should be complied with.

For the major hazard zones outside the Highway 11B corridor, which have been discussed in Section 3 and 4 of this present report, detailed recommendations are provided below. These recommendations incorporate all of the earlier Cunningham recommendations and where possible also provide guidance on prioritising investigative effort.

6.1 Hazard Area A

As shown on Figure 5, numerous near surface stopes exist with back elevations close to ground surface. In addition, the area adjacent to the Nancy Helen Shaft itself, which was capped by Agnico Eagle Mines Ltd. in the 1970's is situated in the backyard of House #56 Galena Street.

Although one diamond drillhole was put down on Galena Street as part of the 1986 watermain investigation programme, to date insufficient information exists on stope geometries or on crown pillar conditions to adequately evaluate the long-term stability of the crown pillars and mine workings in this area. A comprehensive programme of diamond drilling to establish rock mass conditions is therefore required coupled with grid pattern airtrack probing to determine underground opening geometries.

6.2 Hazard Area B

Several near surface stopes exist in the vicinity of Coniagas Road and adjacent dwellings (Figure 6). The #8 and #9 Vein stopes occur close to and probably under the road. Drilling to determine crown pillar rock conditions and overburden depths over these vein complexes is recommended, (for locations of veins - see Figure 3).

The lack of information on the geometry of the crown pillars remaining over the two stopes known to exist under the Public school and school-yard and the lack of data on overburden and tailings thicknesses over the stopes is also of concern. Investigation by geophysical profiling backed up by correlation drilling is therefore recommended for determining subsurface conditions in sufficient detail to adequately assess the stability of the workings.

6.3 Hazard Area C

The seriousness of the hazards posed by the mine workings that have been found in the vicinity of the Senior Citizens Apartment Building and under the Highway 11B corridor through the Miller Avenue/Galena Street intersection area, give cause for concern regarding the likely geometry of stopes developed under Galena Street adjacent to House #16 and under the residential areas adjacent to Miller Street and south along Helen Street. Based on the experience gained in attempting to delineate the geometry of the stoping under the highway, no amount of geophysics on its own will work within the close confines of the houses for identifying the whereabouts of stoped workings. Only a programme of painstaking, angled diamond drilling, followed up by grid pattern probe hole drilling will suffice to gain enough accurate data to

allow engineering solutions to be rationally formulated. The use of downhole camera techniques coupled with ultrasonic distance measurement equipment may have applicability once underground openings have been located. However, in order to initially delineate such openings there does not seem to be any substitute for drilling. In this area, therefore, drilling is initially recommended to be carried out of any possible stoping from the 65 ft. level workings of the City of Cobalt Mine not already investigated by the Phase II highway investigations. For the area south of Miller Avenue, it is suggested that several angled diamond drillholes be drilled westwards from Helen Street, angled under several of the houses that overlie the mapped location of the 65 ft. level drift (Figure 10). Drilling is also necessary at several locations along Galena Street south from Miller Avenue towards Commission Street, particularly adjacent to the boundary of the Townsite Mine property with the Townsite Extension Mine.

6.4 Hazard Area D

The area between the #1 and #2 shafts on the Right of Way North Mine underneath the railway tracks has been extensively stoped. In fact, the #1 shaft, which occurs close to or even under the existing track is reported to have itself been stoped out. Based on the available records, back elevations of the top of the stoping under the railway tracks are within 10m. of ground surface; however, the depth of overburden is unknown. Drilling of this area is recommended.

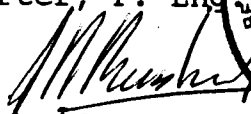
6.5 Additional Study Area

Because of the limited mine workings that are known to exist in the area proposed for the new watermain connection between Contracts 4 and 5, it is recommended

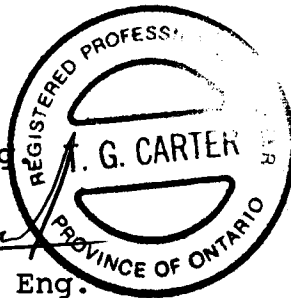
that a detailed topographic survey be carried out of the surface area of interest. This survey should be referenced to old underground mining survey baseline controls in order that a routing can be optimized for the service trench that will avoid all known mine workings. This survey should be plotted at large scale onto a base map and compared directly with a new photogrammetric plan to the same scale produced from the excellent quality 1948 aerial photography available for the area. In this way, delineation of old stockpile areas and old workings should be readily achievable, thereby allowing optimization of an adequate service line routing for construction of the proposed watermain.

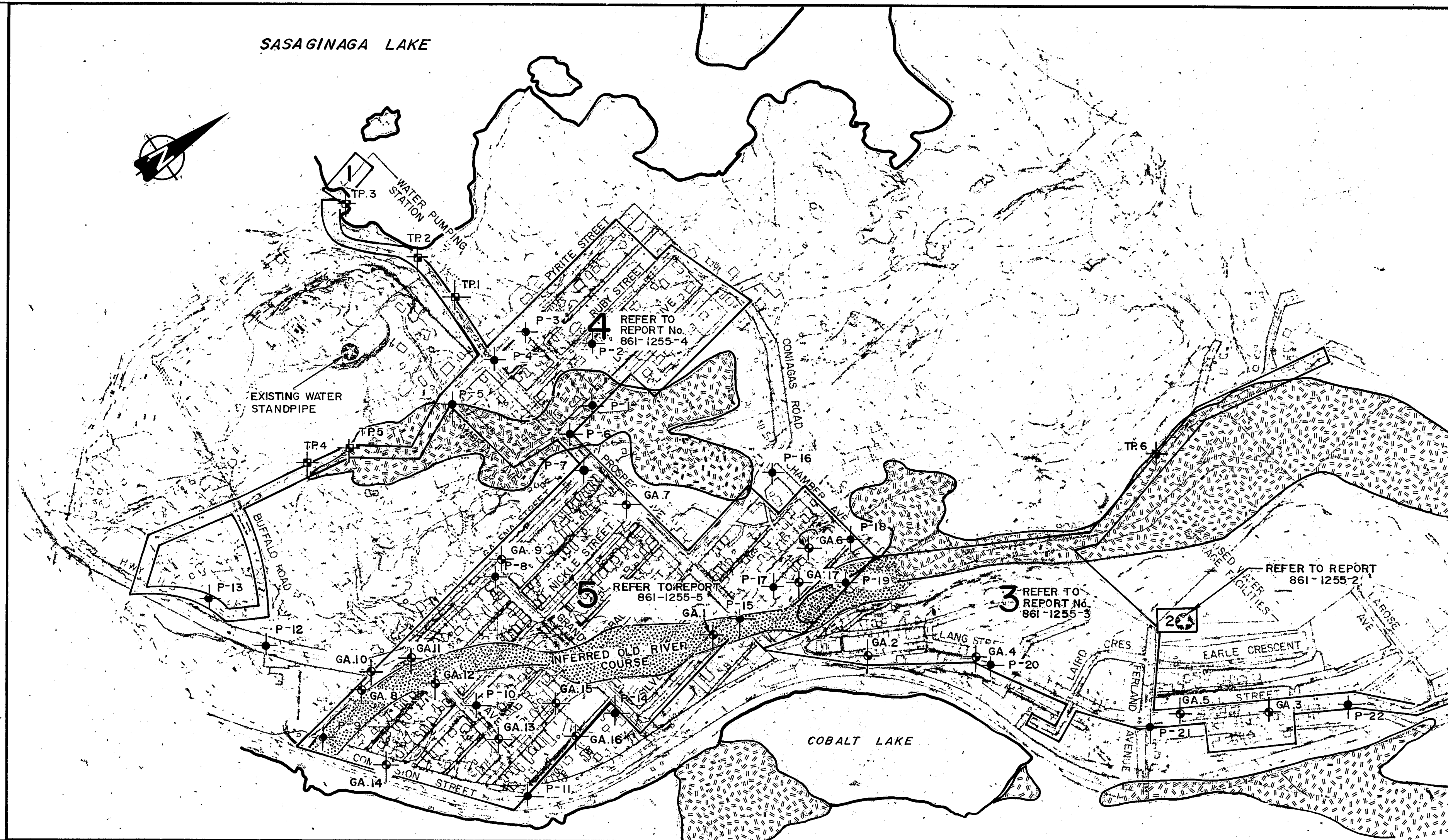
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T.G. Carter, P. Eng.


J.R. Busbridge, P. Eng.

TGC/JRB/dh





LEGEND

- ◆ DIAMOND DRILLHOLE LOCATION IN PLAN
(CARRIED OUT BETWEEN AUG. 25 AND SEPT. 11, 1986)
- AIR TRACK PROBE / HOLE LOCATION
(CARRIED OUT SEPT. 26, 1985 - REFER TO REPORT No. 851-1172 FOR DETAILS)
- ⊕ TEST PIT LOCATION IN PLAN
(TP1-5 CARRIED OUT SEPT. 3, 1986; TP-6 CARRIED OUT BY TOWN WORKS DEPT. DEC. 30, 1986 - JAN. 7, 1987)
- 4 CONTRACT BOUNDARY AND DESIGNATION FOR WATERMAIN CONSTRUCTION
- ▨ OLD RIVER COURSE BASED ON RADAR TRAVERSE DATA.
- ▨ AREA OF KNOWN MINE TAILINGS DEPOSITION

NOTES

1. REFER TO FIGURES 4, 7 AND 8 OF GOLDER ASSOCIATES REPORT No. 851-1172 FOR LOCATION OF RADAR TRAVERSE LINES AND ADDITIONAL DATA ON MINE WORKINGS AND TAILINGS AREAS.
2. REFER TO GOLDER ASSOCIATES REPORTS 871-1289, 871-1347 AND 871-1447 FOR DATA RELATING TO INVESTIGATIONS ALONG THE HIGHWAY 11B CORRIDOR.

REFERENCE

KNOX, MARTIN, KRETCH GENERAL LAYOUT PLANS FOR WATERMAIN CONTRACTS (1986)

SCALE 100 0 100 200 METRES

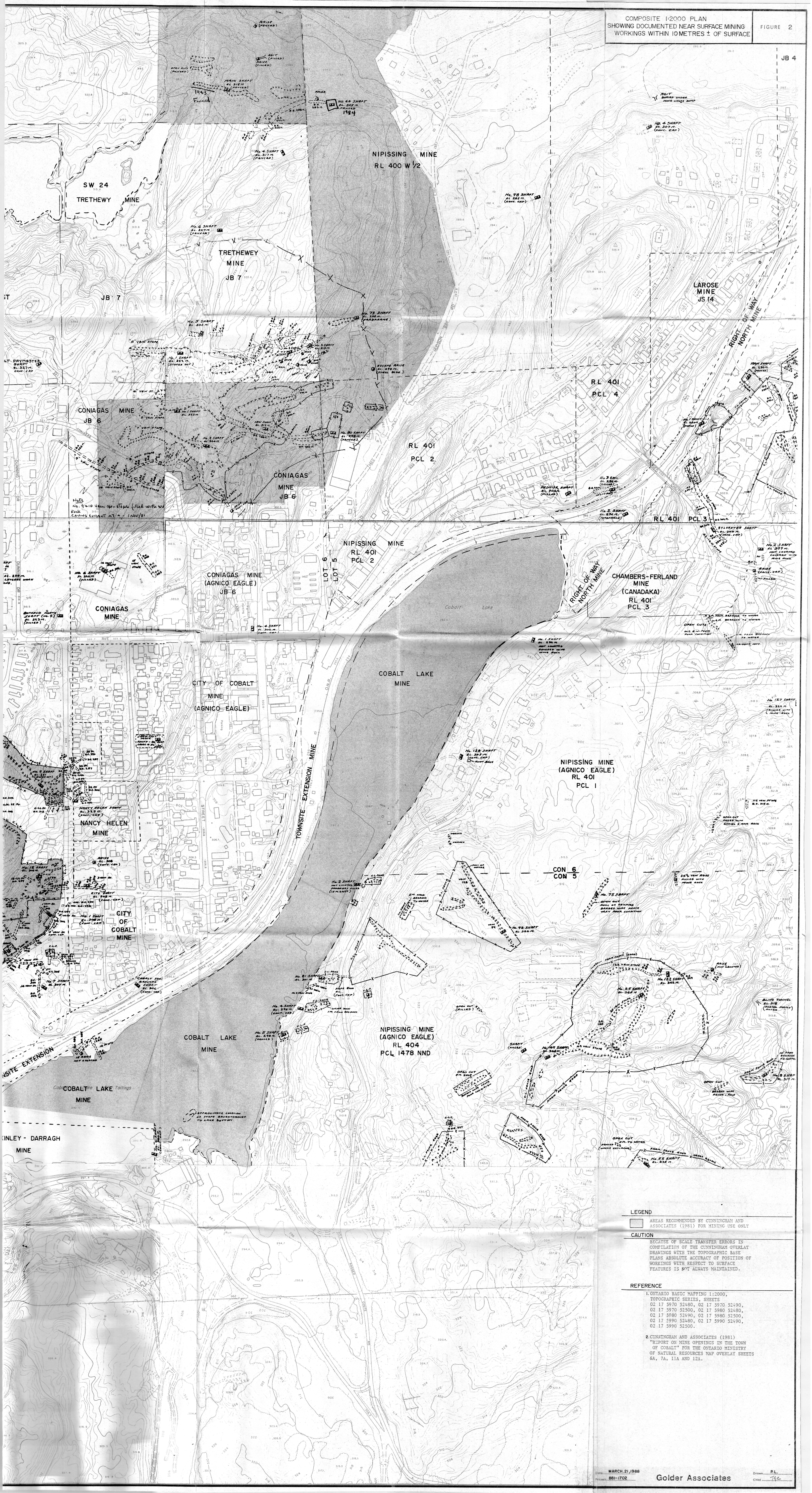
SCALE 1:4000 (APPROX.)

Date: MAR. 21, 1988
Project: 881-1702

Golder Associates

Drawn: D.M.
Chkd: J.C.





LEGEND

AREAS RECOMMENDED BY CUNNINGHAM AND ASSOCIATES (1981) FOR MINING USE ONLY

CAUTION

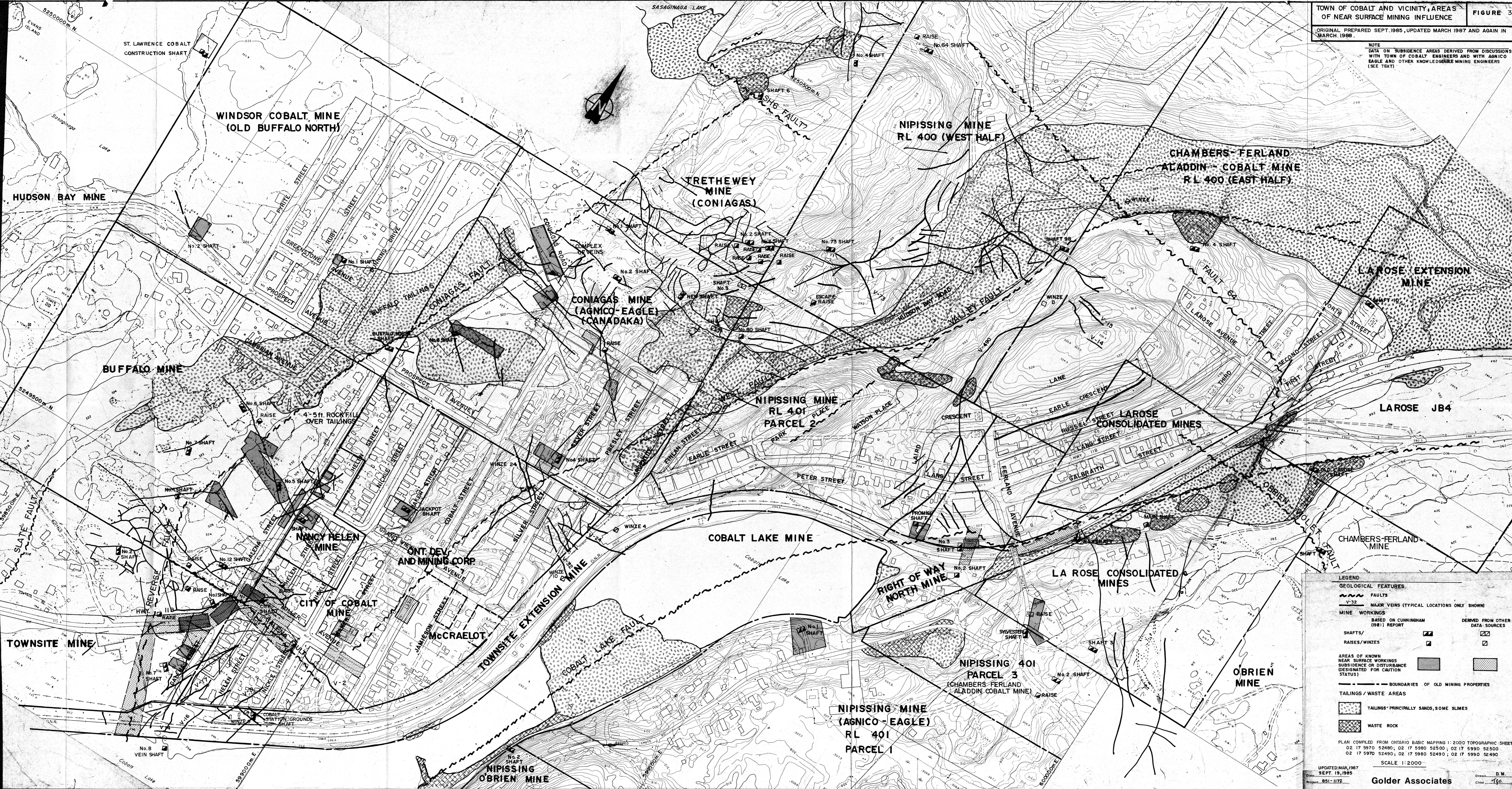
BECAUSE OF SCALE TRANSFER ERRORS IN COMPILED MAPS, THE CUNNINGHAM OVERLAY DRAWINGS WITH THE TOPOGRAPHIC BASE PLANS ABSOLUTE ACCURACY OF POSITION OF WORKINGS WITH RESPECT TO SURFACE FEATURES IS NOT ALWAYS MAINTAINED.

REFERENCE

1. ONTARIO BASIC MAPPING 1:2000, TOPOGRAPHIC SERIES, SHEETS 02 17 5970 52480, 02 17 5970 52490, 02 17 5970 52500, 02 17 5980 52480, 02 17 5980 52490, 02 17 5980 52500, 02 17 5990 52480, 02 17 5990 52490, 02 17 5990 52500.
2. CUNNINGHAM AND ASSOCIATES (1981) "REPORT ON MINE OPENINGS IN THE TOWN OF COBALT" FOR THE ONTARIO MINISTRY OF NATURAL RESOURCES MAP OVERLAY SHEETS 6A, 7A, 11A AND 12A.

ORIGINAL PREPARED SEPT. 1985, UPDATED MARCH 1987 AND AGAIN IN MARCH 1988.

NOTE
DATA ON SUBSIDENCE AREAS DERIVED FROM DISCUSSIONS WITH TOWN OF COBALT ENGINEERS AND WITH AGNICO EAGLE AND OTHER KNOWLEDGEABLE MINING ENGINEERS (SEE TEXT).



LEGEND

GEOLOGICAL FEATURES

- FAULTS
- MAJOR VEINS (TYPICAL LOCATIONS ONLY SHOWN)

MINING WORKINGS

- BASED ON CUNNINGHAM (1981) REPORT
- DERIVED FROM OTHER DATA SOURCES

SHAFTS/RAISES/WINZES

- BASED ON CUNNINGHAM (1981) REPORT
- DERIVED FROM OTHER DATA SOURCES

AREAS OF KNOWN NEAR SURFACE WORKINGS (DESIGNATED FOR CAUTION STATUS)

- BASED ON CUNNINGHAM (1981) REPORT
- DERIVED FROM OTHER DATA SOURCES

BOUNDARIES OF OLD MINING PROPERTIES

TAILINGS/WASTE AREAS

- TAILINGS - PRINCIPALLY SANDS, SOME SLIMES
- WASTE ROCK

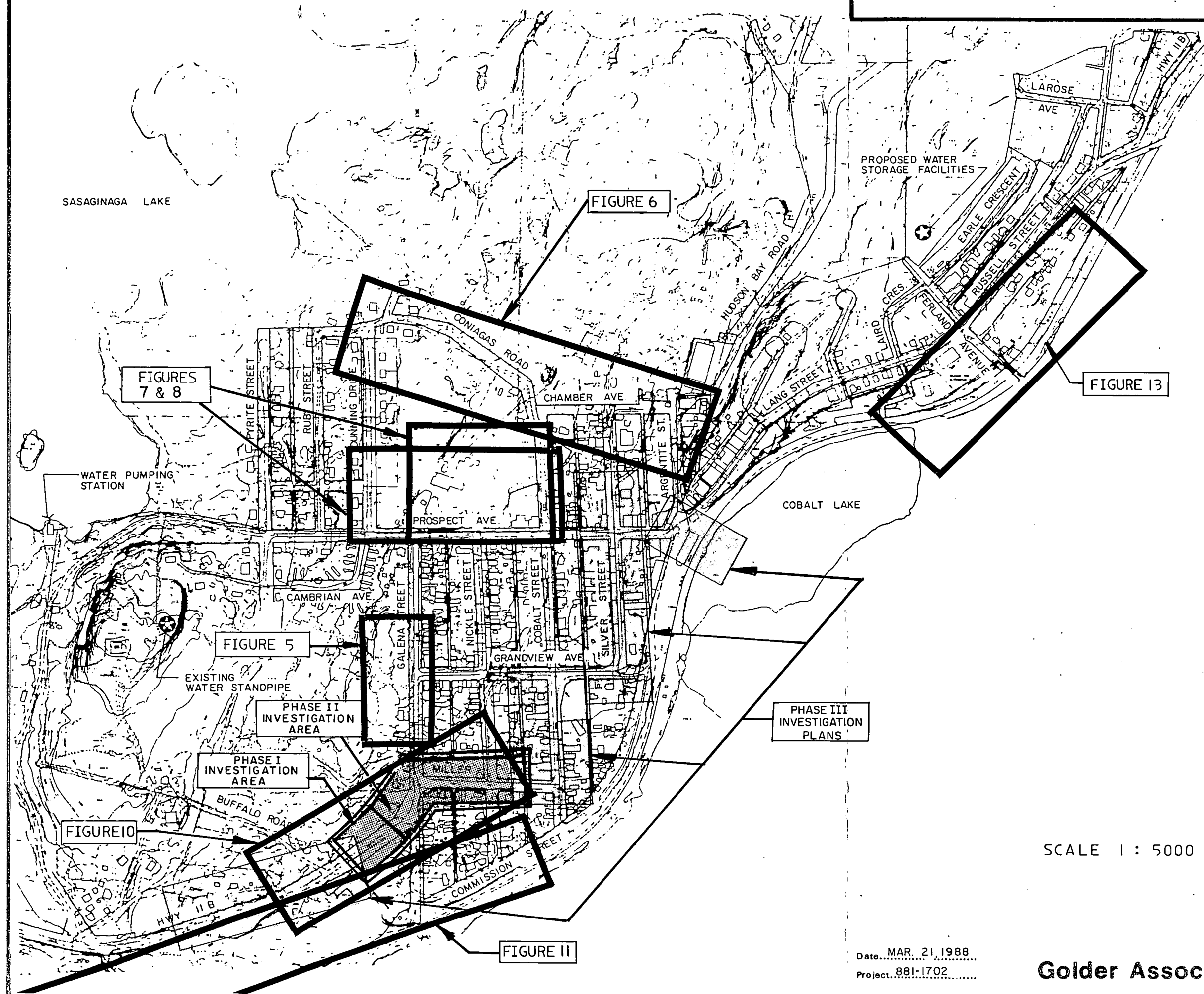
PLAN COMPILED FROM ONTARIO BASIC MAPPING 1:2000 TOPOGRAPHIC SHEETS:
02 17 5970 52480; 02 17 5980 52500; 02 17 5990 52500
02 17 5970 52490; 02 17 5980 52490; 02 17 5990 52490

SCALE 1:2000

UPDATED: MAR. 1987
SEPT. 19, 1985
Project: 891-1172

Golder Associates

Drawn: D.M.
Child: 156



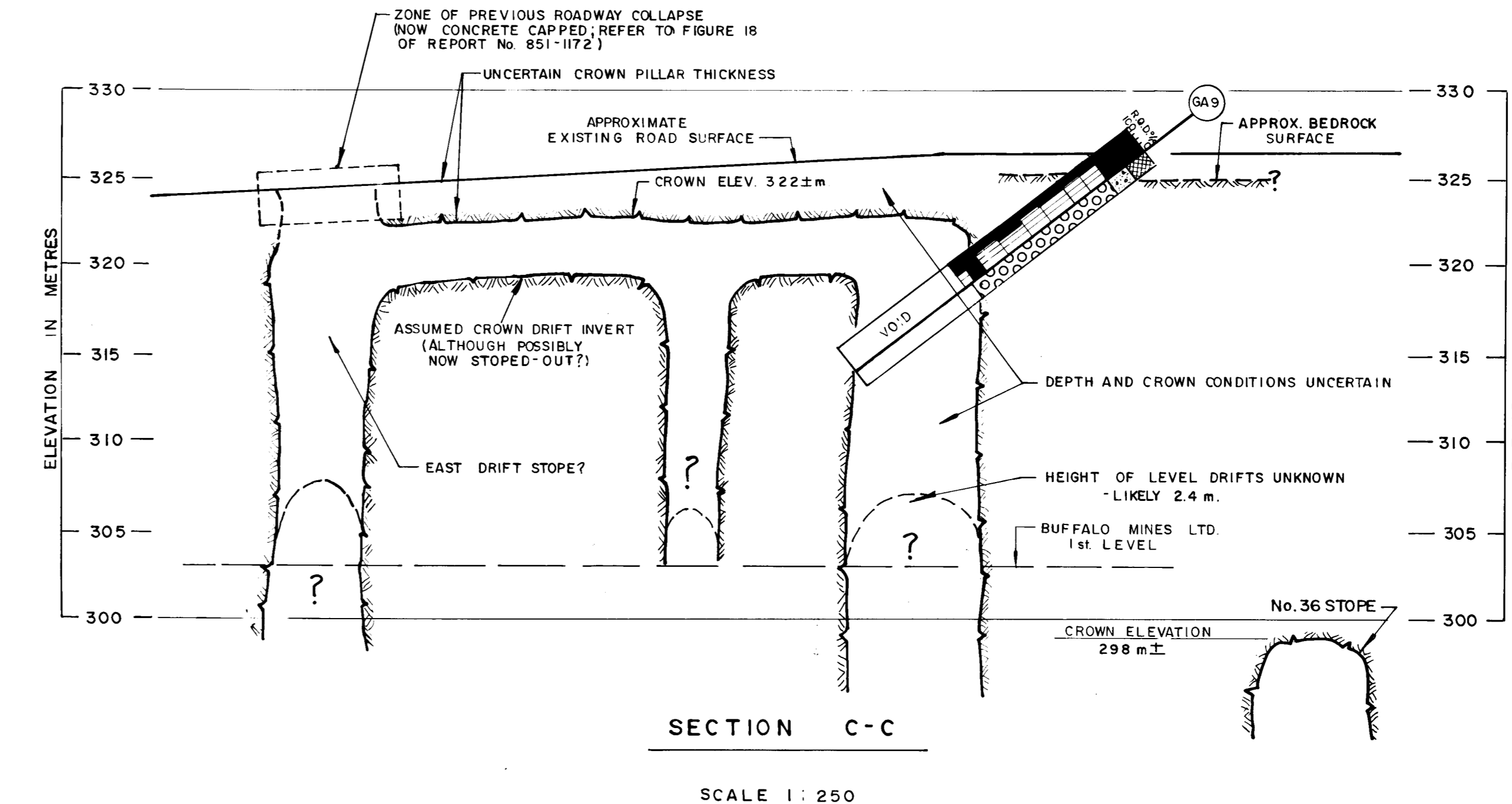
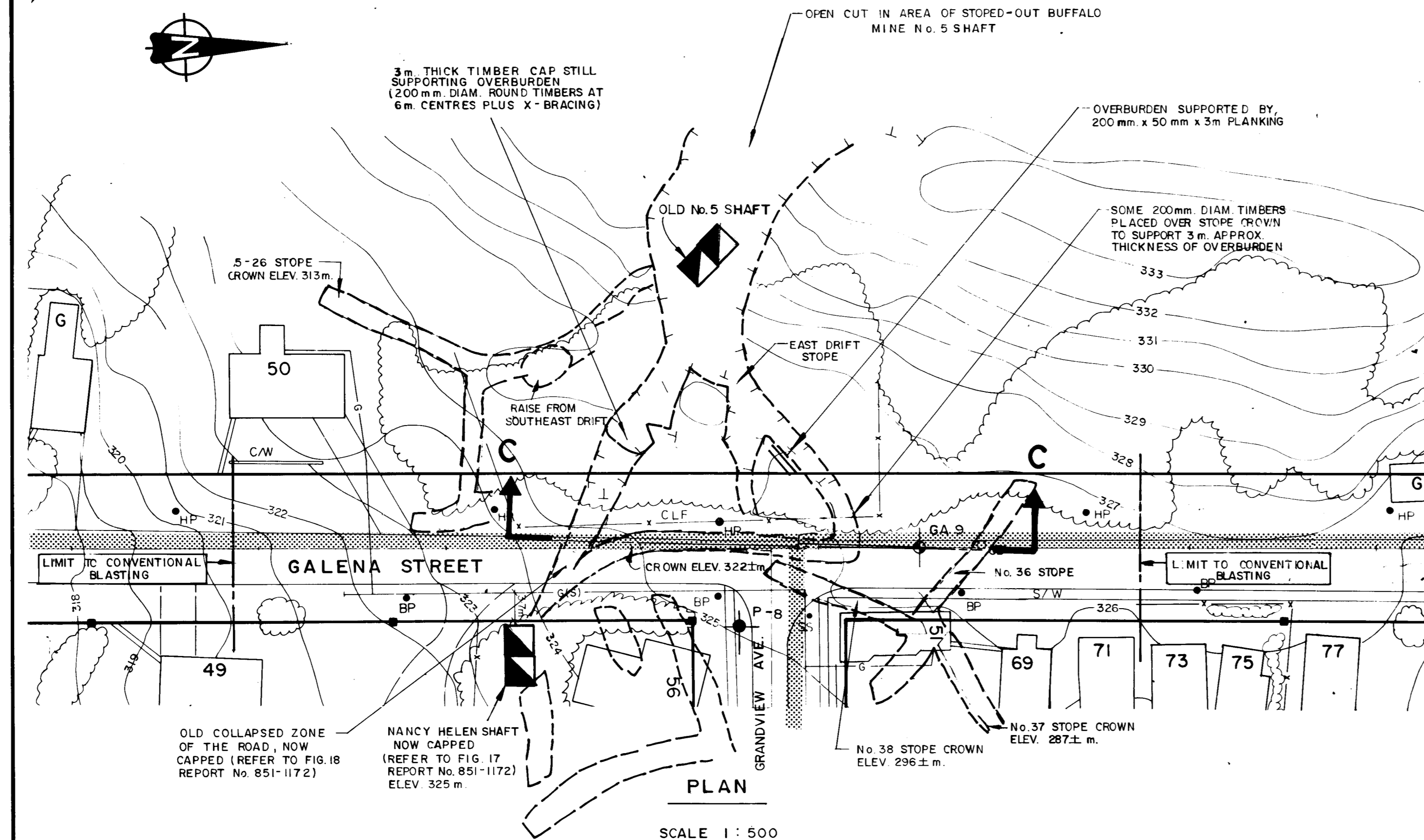
Date.. MAR. 21 1988
Project.. 881-1702

Golder Associates

Drawn... MHW
Chkd... *The*

PLAN AND SECTION OF
GALENA STREET IN AREA OF OLD NANCY
HELEN MINE WORKINGS
SHOWING DOCUMENTED INFORMATION

FIGURE 5



LEGEND

- DIAMOND DRILLHOLE LOCATION IN PLAN (CARRIED OUT BETWEEN AUG. 25 AND SEPT. 11, 1986)
- DIAMOND DRILLHOLE IN ELEVATION (REFER TO RECORD OF BOREHOLE SHEETS FOR DETAILS)
- SIMPLIFIED STRATIGRAPHY (SEE BELOW FOR DETAILS)
- ROCK QUALITY DESIGNATION, PERCENT (SEE RECORD OF BOREHOLE SHEETS FOR DETAILS)
- RADAR TRAVERSE LINES
- PLAN OUTLINES OF STOPES AND UNDERGROUND DRIFTS
- LOCATION OF 2 COMPARTMENT SHAFTS

STRATIGRAPHY

- SAND AND GRAVEL (FILL)
- FINE TO MEDIUM COARSE GRAVEL (SUBROUNDED TO ROUNDED) WITH COBBLES OF CONGLOMERATE
- SLIGHTLY WEATHERED, MASSIVE LIGHT TO MEDIUM GREY CONGLOMERATE COMPRISING FINE GRAINED MATRIX AND FINE TO MEDIUM AND COARSE ROUNDED GRAVEL AND COBBLE FRAGMENTS OF GRANITE (GOWGANDA FORMATION)

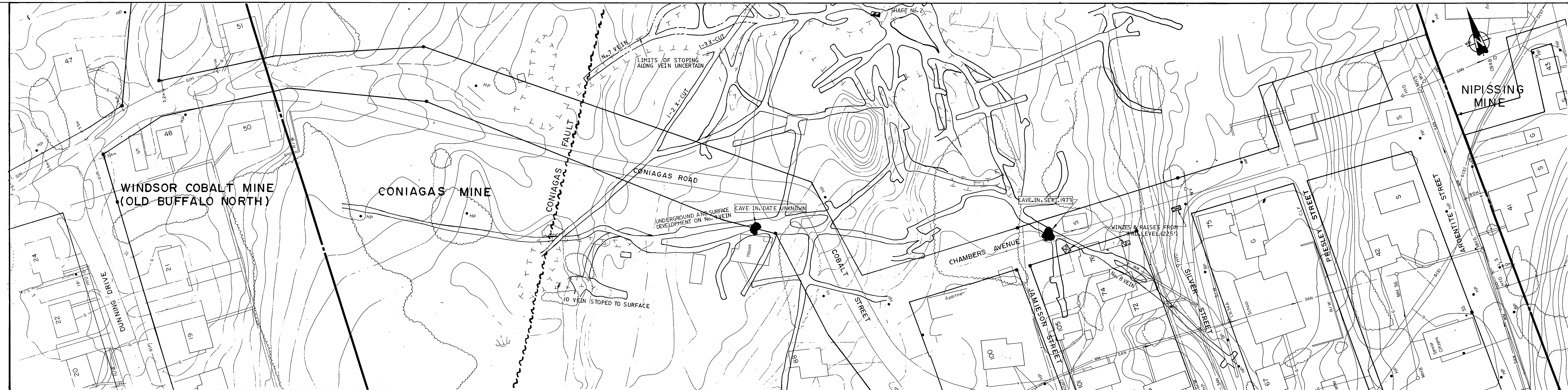
NOTE

STOPE GEOMETRY EXTRAPOLATED FROM BUFFALO MINES AND NANCY HELEN MINES OLD MINING RECORD LEVEL PLANS DATING FROM 1908 AND FROM CORRELATION 1:2000 PLAN SHEET 11 OF CUNNINGHAM 1981 REPORT (REFER TO GOLDER ASSOC. REPORT No. 851-1172 FOR DETAILS)

Date: MAR. 18, 1988
Project: 881-1702

Golder Associates

Drawn: D.M.
Chkd: J.C.



- LEGEND
- UNDERGROUND WORKINGS
- 1ST. LEVEL CONIAGAS, 75 FT. LEVEL
 - 2ND. LEVEL CONIAGAS, 150 FT. LEVEL
- 2 COMPARTMENT SHAFTS
- RAISES
- WINZES
- MINING PROPERTY BOUNDARIES
- FAULTS
- OPEN CUTS AND UNDERGROUND WORKINGS
BROKEN UP TO SURFACE

NOTE

INCONSISTENCIES BETWEEN PLANS USED TO COMPILE THIS
FIGURE EXIST; THEREFORE BEST ESTIMATE LOCATIONS
OF WORKINGS SHOWN.

- REFERENCES
- 1) COMPOSITE PLAN OF CONIAGAS PROPERTY FROM
AGNICO-EAGLE MINES LTD. UNDATED, CIRCA 1920. 1" TO 40'.
 - 2) SHEET 7, 02 17 5990 52500, OVERLAYS A AND B
ONTARIO BASIC MAPPING 1:2000, TOPOGRAPHIC SERIES,
L.J. CUNNINGHAM & ASSOC. LTD. REPORT ON MINE OPENINGS
IN THE TOWN OF COBALT, 1981.
 - 3) SHEET 6, 02 17 5980 52500, OVERLAYS A AND B
ONTARIO BASIC MAPPING 1:2000, TOPOGRAPHIC SERIES,
L.J. CUNNINGHAM & ASSOC. LTD. REPORT ON MINE OPENINGS
IN THE TOWN OF COBALT, 1981.
 - 4) PLAN TITLED MURPHY & LANDRY DATED AUG. 1942, 1" TO 50'
FROM AGNICO-EAGLE MINES LTD.

LEGEND
UNDERGROUND WORKINGS
150 FT. LEVEL
SHAFT
MINING PROPERTY BOUNDARY
FAULT

NOTES
1) INCONSISTENCIES BETWEEN PLANS USED TO COMPILE THIS FIGURE EXIST; THEREFORE BEST ESTIMATE OF LOCATIONS ARE SHOWN.
2) FOR SECTIONS A-A, B-B AND C-C REFER TO FIGURE 9.

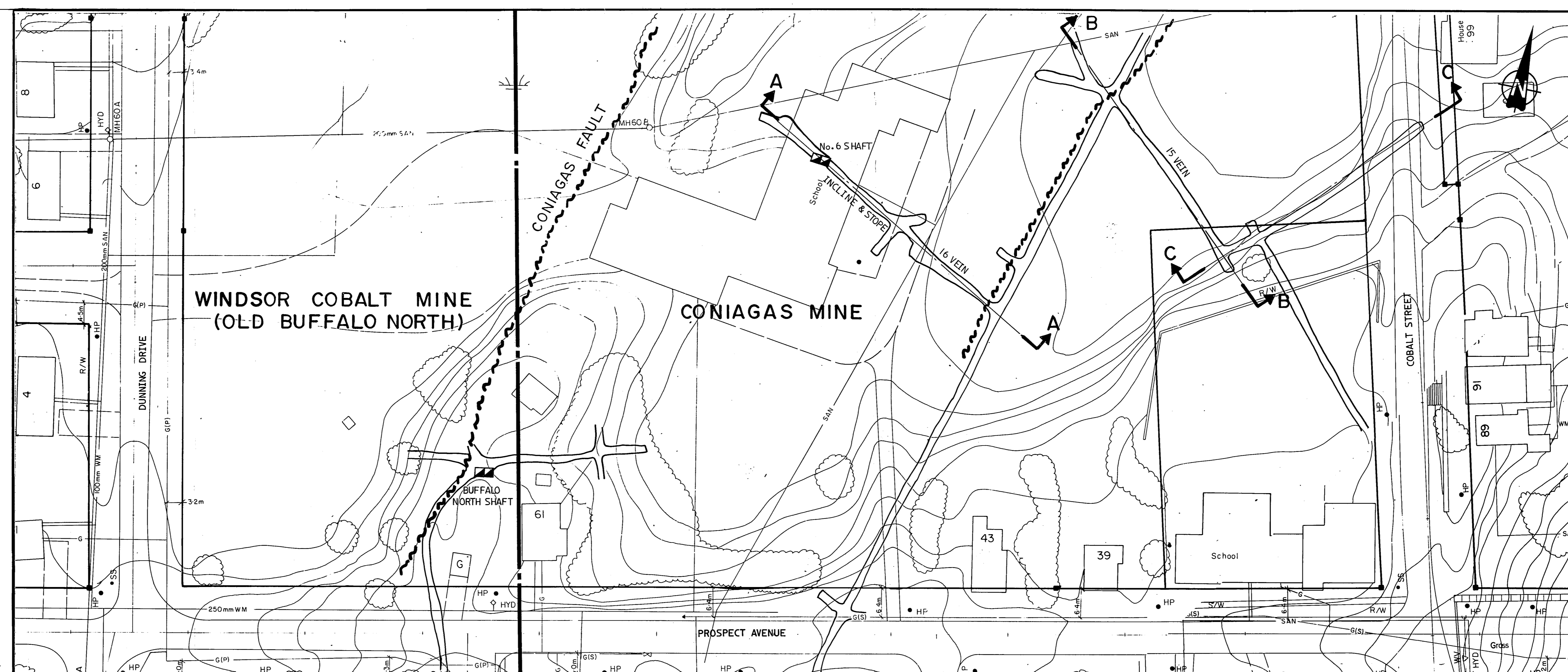
REFERENCES
1) PLAN TITLED CONIAGAS MINES LTD., SURFACE & UNDERGROUND WORKINGS, AGNICO-EAGLE MINES LTD., DATED OCT. 1916
2) PLAN TITLED MURPHY & LANDRY DATED AUG. 1942, 1" TO 50' FROM AGNICO-EAGLE MINES LTD. RECORDS.
3) SHEET 11, 02 17 5980 52490 OVERLAY B AND SHEET 12, 02 17 5990 52490 OVERLAY A; ONTARIO BASIC MAPPING 1:2000, TOPOGRAPHIC SERIES. L.J. CUNNINGHAM & ASSOC. LTD. REPORT ON MINE OPENINGS IN THE TOWN OF COBALT, 1981.

SCALE 1:500

Date MAR. 16, 1988
Project 88-1-1702

Golder Associates

Drawn D. M.
Chkd



ELEVATIONS
ELEVATIONS ARE DERIVED FROM AN ASSUMED
ELEVATION OF 100.00 FT. FROM THE MAIN FLOOR
OF THE COBALT PUBLIC SCHOOL

LEGEND
□ 2.5" B DENOTES 1 IN. SQ. IRON BAR 2.0 FT. LONG
■ 1" B DENOTES 5/8 IN. SQ. IRON BAR 2.0 FT. LONG
○ C.I.P. DENOTES CROWN LANDS IRON POST

NEW Liskeard, Ontario
MAY 29 TH 1975

R.W. FARRELL
ONTARIO LAND SURVEYOR

TOPOGRAPHIC PLAN
OF PART OF
LOT 42 PLAN M-47N.B.
TOWN OF COBALT
DISTRICT OF TIMISKAMING

SCALE: 1 INCH = 20 FEET
R.W. FARRELL OLS. 1975

TIMISKAMING BOARD OF EDUCATION
COBALT PUBLIC SCHOOL

- NOTES:
1. COMPOSITE DRAWING COMPILED FROM TWO PLANS BY H. SUTCLIFFE LTD.
- COBALT PUBLIC SCHOOL, SOUNDINGS AND ELEVATIONS
DATED SEPT. 8, 1956
- TOPOGRAPHIC PLAN OF PART OF LOT 42, PLAN M-47 NB
DATED MAY, 1975
 2. SHAF 76 OF CONIACAS MINE WORKINGS, SEWER TRENCHES AND
SLIMES LIMIT SHOWN ON SOUNDINGS DRAWING
 3. ELEVATIONS ON SOUNDING GRID OVER SCHOOL AREA TO DIFFERENT
(UNDEFINED) DATUM THAN SHOWN ELSEWHERE ON MAIN TOPOGRAPHIC
PLAN



- SOUNDINGS
- A-01: SLIMES FOR 5' THEN LOOSE ROCK.
A-25: SLIMES FOR 7' THEN LOOSE OR SOLID ROCK.
A-50: SLIMES FOR 8' THEN LOOSE OR SOLID ROCK.
A-75: SLIMES FOR 9' THEN LOOSE OR SOLID ROCK.
A-100: SLIMES FOR 10' THEN LOOSE ROCK.
A-125: SLIMES FOR 12' THEN LOOSE OR SOLID ROCK.
A-150: SLIMES FOR 14' THEN LOOSE OR SOLID ROCK.
A-175: CLAY LOAM & LOOSE BOULDERS FOR 2' THEN SOLID ROCK.
B-01: SLIMES FOR 3.5' THEN BOULDERS OR SOLID ROCK.
B-25: SLIMES FOR 4.5' THEN SOLID ROCK.
B-50: SLIMES FOR 4.5' THEN LOOSE OR SOLID ROCK.
B-75: SLIMES FOR 4' THEN LOOSE ROCK.
B-100: SLIMES FOR 4.5' THEN SOLID ROCK.
B-125: SLIMES FOR 2.4' THEN SOLID ROCK.
B-150: SANDY CLAY & BOULDERS FOR 3' THEN SOLID ROCK.
B-175: CLAY LOAM & LOOSE BOULDERS FOR 3.7' THEN SOLID ROCK.
C-01: SLIMES FOR 2' THEN SOLID ROCK.
C-25: SOLID ROCK ON SURFACE.
C-50: SLIMES FOR 3.2' THEN SOLID ROCK.
C-75: SLIMES FOR 2.8' THEN SOLID ROCK.
C-100: SLIMES 1', GRAVELLY CLAY 2.5' THEN LOOSE ROCK.
C-125: BLACK LOAM 1', GRAVELLY CLAY 1.8' THEN SOLID ROCK.
C-150: BLK. LOAM 5', GRAV. CLAY 4.5' THEN S. ROCK OR BOULDERS.
C-175: CLAY LOAM FOR 2.6' THEN SOLID ROCK.
D-01: SANDY LOAM FOR 3.1' THEN SOLID ROCK OR BOULDERS.
D-25: SANDY LOAM FOR 3.7' THEN SOLID ROCK.
D-50: SLIMES FOR 4' THEN SOLID ROCK OR LARGE BOULDERS.
D-75: GRAVELLY CLAY FOR 8.5' THEN SOLID ROCK.
D-100: LOAM FOR 0.5' THEN SOLID ROCK.
D-125: SANDY CLAY FOR 4' THEN SOLID ROCK.
D-150: CLAY LOAM FOR 2.7' THEN SOLID ROCK.
D-175: CLAY LOAM FOR 2.4' THEN SOLID ROCK.
E-01: SANDY LOAM FOR 4.1' THEN SOLID ROCK OR LARGE BOULDERS.
E-25: SANDY LOAM & LOOSE BLDRS 2' THEN S. ROCK/LARGE BLDRS.
E-50: SANDY CLAY FOR 4' THEN SOLID ROCK.
E-75: BLK. LOAM & LOOSE BLDRS 1.8' THEN S. ROCK/LARGE BLDRS.
E-100: 1'S. CONGLOMERATE TO SURFACE 4' SOUTH.
E-125: CLAY LOAM FOR 2.4' THEN SOLID ROCK.
E-150: CLAY LOAM FOR 2' THEN SOLID ROCK.
E-175: CLAY LOAM FOR 0.2' THEN SOLID ROCK.
F-01: SANDY LOAM FOR 3' THEN SOLID ROCK.
F-25: SANDY CLAY FOR 4.4' THEN SOLID ROCK.
F-50: CLAY LOAM FOR 2.4' THEN LOOSE BOULDERS/SOLID ROCK.
F-75: LOOSE SURFACE BLDRS. FOR 2.4' THEN S.R. OR BOULDERS.
F-100: CLAY LOAM & LOOSE BLDRS. FOR 1.2' THEN SOLID ROCK.
F-125: SANDY LOAM & SURFACE BOULDERS FOR 3.8' THEN S.R.
F-150: SANDY LOAM FOR 3' THEN SOLID ROCK OR LARGE BLDRS.
F-175: LOAM FOR 1' THEN SOLID ROCK, BLASTED.
G-01: SLIMES IN TRENCH, 2.6' THEN LOOSE OR SOLID ROCK.



REFERENCES

- 1) SECTIONS ALONG VEINS 15 AND 16, CONIAGAS MINE, OCT. 1916
(FROM AGNICO-EAGLE MINES LTD. RECORDS)
- 2) SECTION ALONG VEIN 15 LAKE 3RD. STOPE, CONIAGAS MINE
OCT. 1925 (FROM AGNICO-EAGLE MINES LTD) SCALE: 1" TO 20'

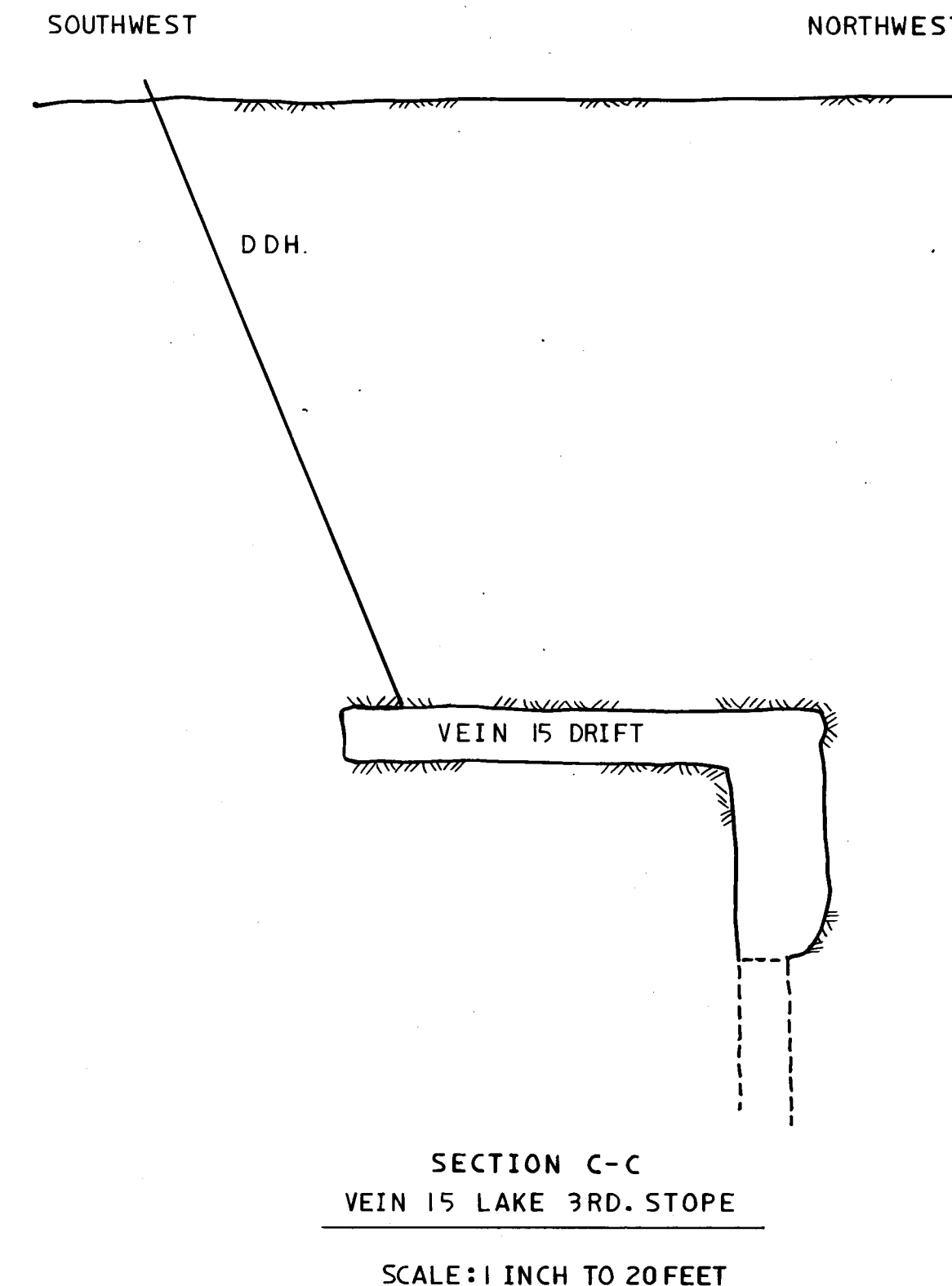
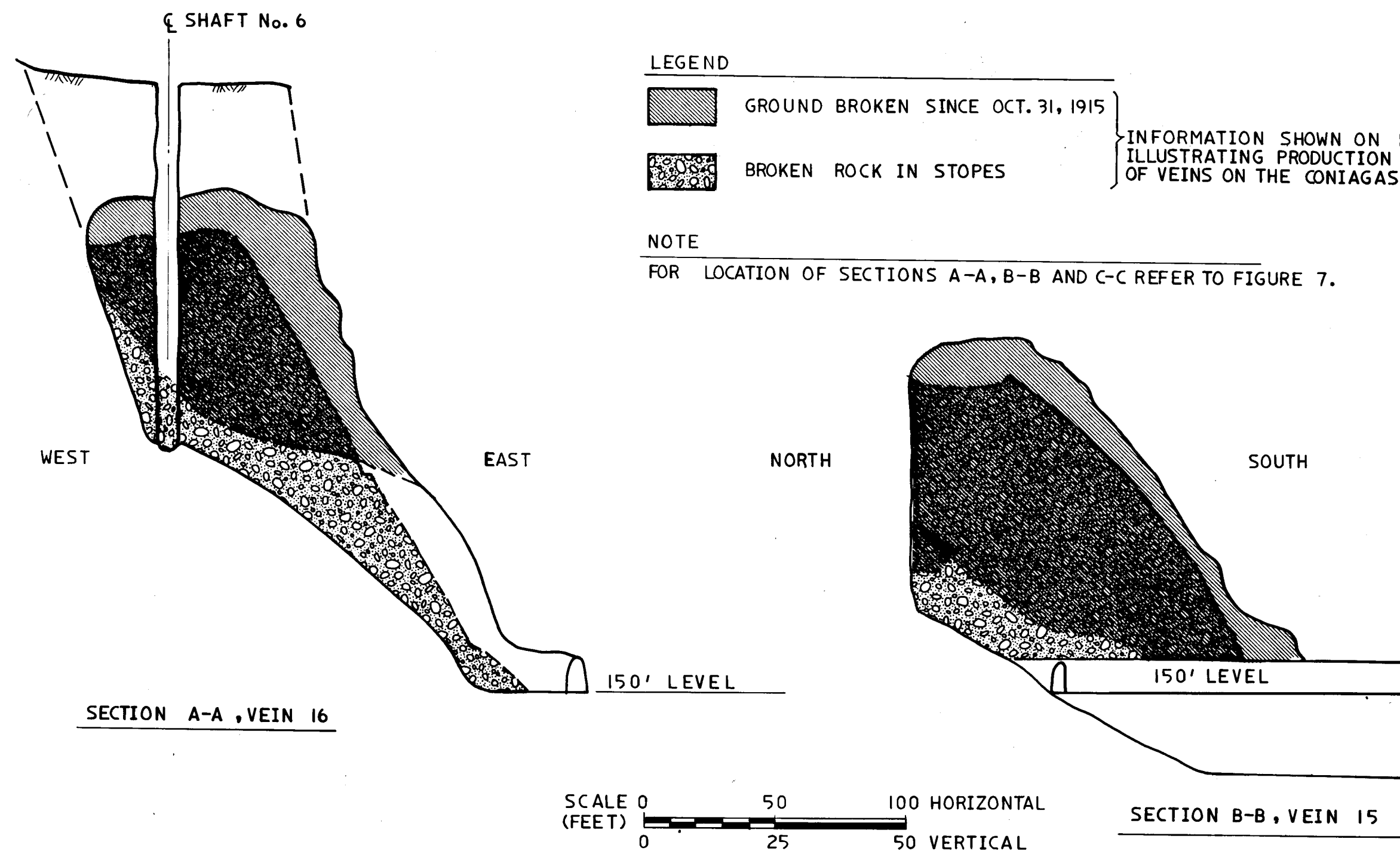
LEGEND

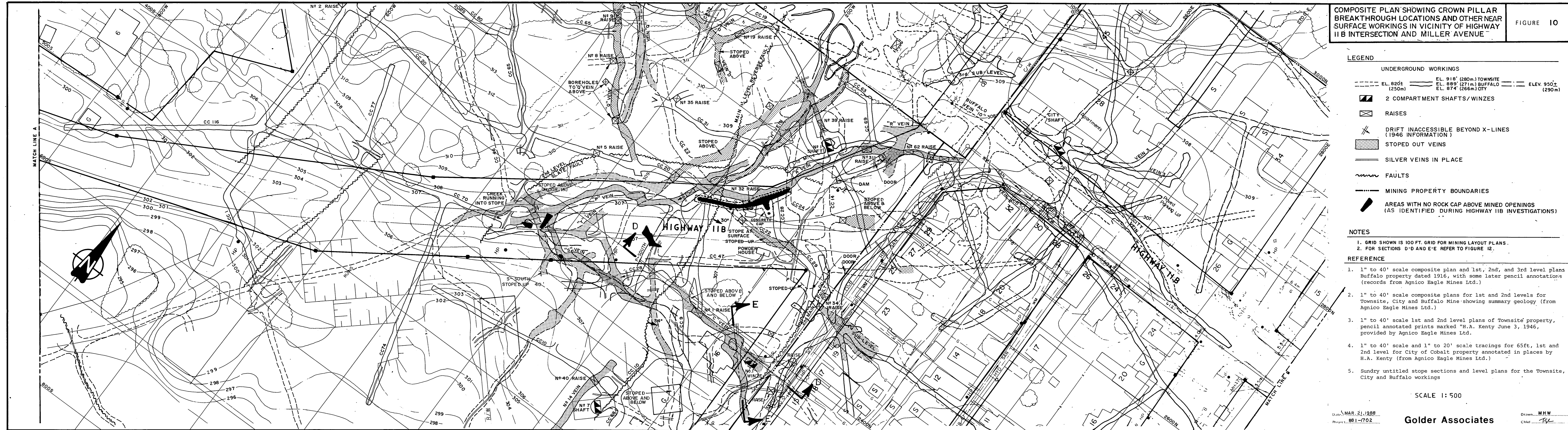
-  GROUND BROKEN SINCE OCT. 31, 1915
-  BROKEN ROCK IN STOPES

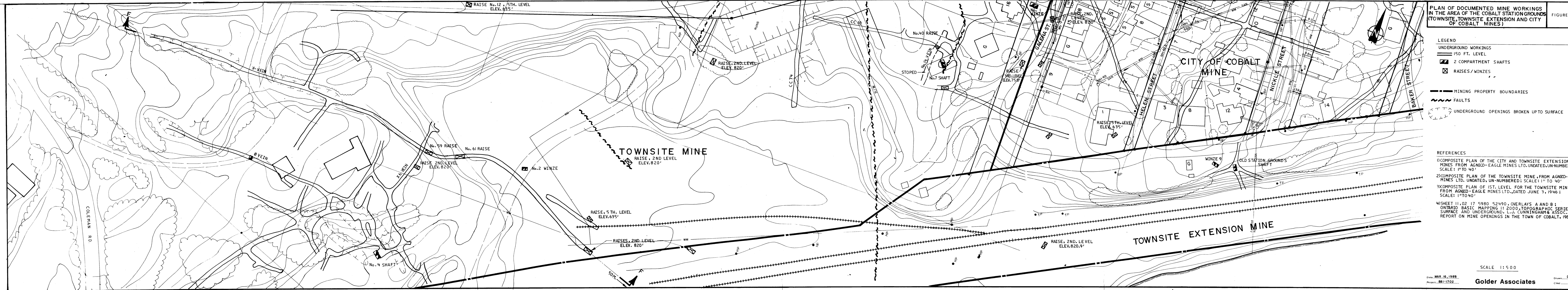
INFORMATION SHOWN ON 1916 DRAWING
ILLUSTRATING PRODUCTION FROM STOPING
OF VEINS ON THE CONIAGAS PROPERTY

NOTE

FOR LOCATION OF SECTIONS A-A, B-B AND C-C REFER TO FIGURE 7.





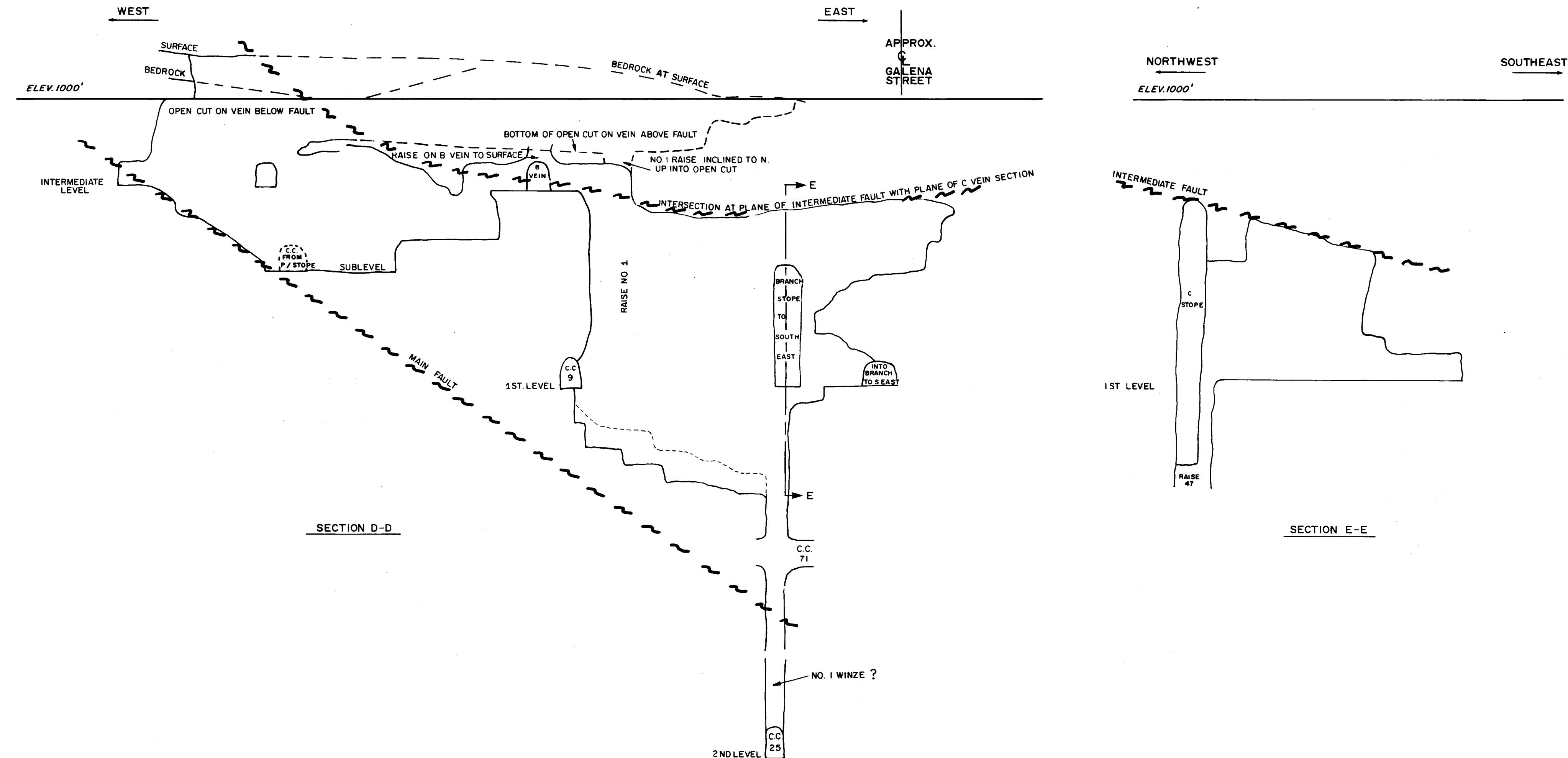


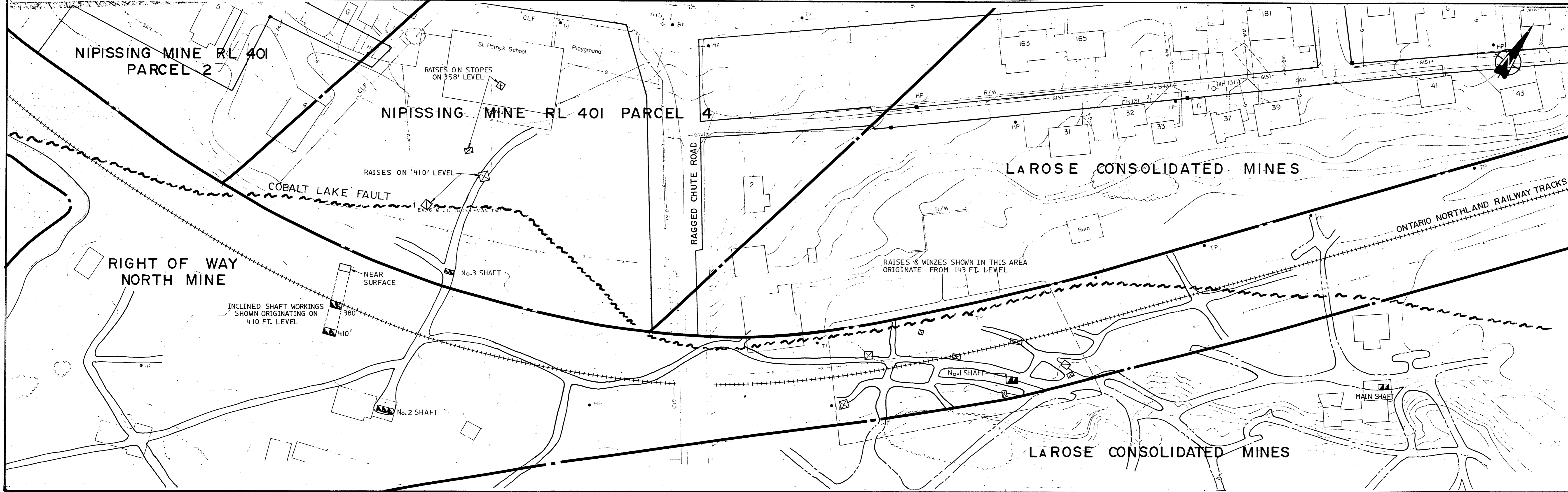
PLAN OF DOCUMENTED MINE WORKINGS
IN THE AREA OF THE COBALT STATION GROUNDS
(TOWNSITE, TOWNSITE EXTENSION AND CITY
OF COBALT MINES)

FIGURE 11

- LEGEND
- UNDERGROUND WORKINGS
 - 150 FT. LEVEL
 - 2 COMPARTMENT SHAFTS
 - RAISES/WINZES
 - MINING PROPERTY BOUNDARIES
 - FAULTS
 - UNDERGROUND OPENINGS BROKEN UP TO SURFACE

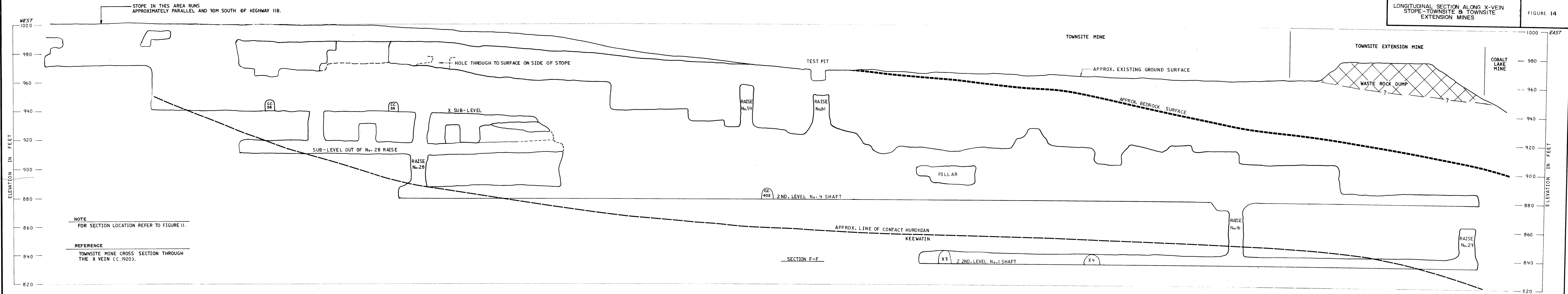
- REFERENCES
- 1) COMPOSITE PLAN OF THE CITY AND TOWNSITE EXTENSION MINES FROM AGNICO-EAGLE MINES LTD., UNDATED, UN-NUMBERED; SCALE: 1" TO 40'
 - 2) COMPOSITE PLAN OF THE TOWNSITE MINE, FROM AGNICO-EAGLE MINES LTD., UNDATED, UN-NUMBERED; SCALE: 1" TO 40'
 - 3) COMPOSITE PLAN OF 1ST. LEVEL FOR THE TOWNSITE MINE, FROM AGNICO-EAGLE MINES LTD., DATED JUNE 3, 1946; SCALE: 1" TO 40'
 - 4) SHEET 11, 02 17 5980 52490, OVERLAYS A AND B; ONTARIO BASIC MAPPING 1: 2000, TOPOGRAPHIC SERIES SURFACE AND UNDERGROUND, L.J. CUNNINGHAM & ASSOC. LTD. REPORT ON MINE OPENINGS IN THE TOWN OF COBALT, 1981.





- LEGEND**
- UNDERGROUND WORKINGS
 - 62 FT. LEVEL
 - 83 FT. LEVEL
 - SHAFT
 - RAISES
 - WINZES
 - MINING PROPERTY BOUNDARIES
 - FAULTS

- NOTES**
- 1) FOR ADDITIONAL INFORMATION ON THIS AREA REFER TO FIGURES 3 AND 4; GOLDER ASSOC. REPORT No. 861-1255-2 DATED SEPT. 10, 1986.
- 2) GEOMETRY OF WORKINGS FROM No. 2 SHAFT SHOWN ON THIS DRAWING DIFFER FROM ALADDIN COBALT MINE DRAWINGS OF SAME AREA AS SHOWN ON DRAWINGS REFERENCED ABOVE.
- REFERENCES**
- 1) COMPOSITE PLAN FOR RIGHT OF WAY, NORTH PROPERTY AGNICO EAGLE MINES LTD. UNDATED, CIRCA 1920; SCALE 1" TO 40'.
- 2) SHEET 7, 02 17 5990 52500, OVERLAYS A AND B ONTARIO BASIC MAPPING 1:2000, TOPOGRAPHIC SERIES FROM L.J. CUNNINGHAM & ASSOC. LTD. REPORT ON MINE OPENINGS IN THE TOWN OF COBALT, 1981.



SCALE: 1 INCH TO 20 FEET