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SLOPE STABILITY EVALUATION

8606 SASKATCHEWAN DRIVE NW
EDMONTON, ALBERTA

LOT 2, BLOCK A, PLAN 2010HW

Prepared for

LOUIS CSABA

MAY 2014

CTA File No. 02-1781

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Prepared by,

CT & ASSOCIATES ENGINEERING INC.

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DSN/CTH/

PERMIT TO PRACTICE
CT & ASSOCIATES ENGINEERING INC.
Signature
Date May 30, 2014
PERMIT NUMBER: P 7826
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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APPENDICES

1.0 INTRODUCTION

This report presents the results of a Slope Stability Evaluation conducted by CT & Associates Engineering Inc. for the property located at the municipal address of 8606 Saskatchewan Drive NW, Edmonton, Alberta.

It is proposed to demolish the existing residential dwelling and detached garage at the property, and construct a new residential structure within the property.

As such, the purpose of this study was to evaluate long term stability of the slope and to determine appropriate setback distances for the new building structure from the top-of-bank of the North Saskatchewan River Valley ravine that extends along the west boundary of the property. Design recommendations and construction guidelines are also presented for the proposed dwelling.

Authorization to proceed with the project was provided by Louis Csaba on April 1, 2014.

2.0 SITE DESCRIPTION

The subject site is located at the municipal address of 8602 Saskatchewan Drive, located in central Edmonton, Alberta. The legal land description of the site is Lot 1, Block A, Plan 2010HW. The subject site covers approximately 0.25 acre (0.1 ha) of land. The property is now occupied by a single-storey residential dwelling with detached garage, with remaining portions utilized for grassy landscaped areas.

To the immediate west of the property is the North Saskatchewan River slope which is extensively covered with mature trees, shrubs, and bushes.

The site is bounded on the east by a service road of Saskatchewan Drive, on the north and south by residential properties, and further to the south for a municipal park.

The surrounding areas to the east of the subject site is occupied by a residential subdivision, the topography of which is relatively flat and gently sloping towards the river valley.

The location of the subject site is shown on Drawing No. A-1, Appendix A, with surface contours presented on Drawing No. A-2. Representative site photos are included in Appendix B.

3.0 BACKGROUND INFORMATION

In August, 2009, CTA had prepared a similar Slope Stability Evaluation for the property to the immediate south, on behalf of the same client, Mr. Louis Csaba. Results of this study were presented in the following document:

Slope Stability Evaluation, 8602 Saskatchewan Drive NW, Edmonton, Alberta.
Lot 1, Block A, Plan 2010 HW." Prepared for Louis Csaba,
August, 2009. CTA File No. 02-987.

This document had been prepared for a similar purpose as the present study, demolition of an existing residence and construction of a new structure, according to the developed set-back distances. The new residence has since been constructed.

In view of the immediate proximity of this adjacent property and same client, applicable information from this 2009 study has been incorporated into the present, including historical and site information, and details of the deep soil stratigraphy.

This is further supplemented and updated with additional information to provide site-specific and current information pertaining to the present subject site.

4.0 FIELD INVESTIGATION

4.1 SITE STUDY AND SITE RECONNAISSANCE

A review of historical air photos pertaining to the slope conditions adjacent to the site, and a detailed site visit was conducted to assess historical and existing slope conditions in vicinity of the subject site.

The drilling program was subsequently planned to investigate the soil and groundwater conditions and to evaluate the slope stability.

4.2 DRILLING PROGRAM

During the 2009 site study of 8602 Saskatchewan Drive, two boreholes were drilled within this adjacent property (about 10 m south of the present site), including:

1) One deep borehole (Borehole No. 09-1) was drilled near the top-of-bank to a depth of 38.9 m (about 17 m into bedrock), to investigate the soil and bedrock conditions at depth for slope stability evaluation; and
2) Borehole No. 09-2 was drilled in vicinity of the proposed building footprint to determine geotechnical parameters for the design of the proposed new building structure.

To supplement this and to provide additional site- specific information to the present site, additional boreholes have been drilled within the present site.

This included:

1) One deep borehole (Borehole No. 14-01), to 24 m depth (about 6 m into bedrock), drilled on May 2, 2014; and
2) One shallow probehole (Borehole No. 14-02) was also hand augered on the west side of the existing residence, such to identify thickness of any grading materials placed over this portion of the property.

Drawing No. A-2, Appendix A, shows the borehole locations.

Drilling of the deep boreholes was conducted with a B-61 truck-mounted drill rig, utilizing a 150 mm diameter solid steel auger. Disturbed samples were taken from auger cuttings typically at 0.8 m intervals. Standard Penetration Testing (SPT) with split spoon sampling was also undertaken at 1.5 m intervals. Supervision of the drilling program, classification of all samples, and installation of the piezometers were performed by a CT & Associates Engineering Inc. engineer.

Laboratory testing was also conducted on soil samples for the determination of natural moisture content, and soluble sulphate concentration.

Detailed descriptions of the soil conditions are presented on the individual borehole logs found in Appendix C.

5.0 SITE HISTORICAL STUDY

5.1 HISTORICAL AIR PHOTO REVIEW

A review of historical air photos was conducted for the subject site and surrounding properties for the period of 1924 through 2013, as available from the Province of Alberta Sustainable Resource Development Air Photo Archives and City of Edmonton Archives.

Photos reviewed were dated 1924, 1930, 1950, 1954, 1962, 1967, 1969, 1971, 1974, 1978, 1980, 1984, 1986, 1990, 1995, 2002, 2005, 2007, and 2013.

The site and slope conditions are summarized as follows:

1924 - Subject site and upland area vacant of development with no instabilities noted on the adjacent slope. A small access road present at the location of the existing Saskatchewan Drive though portions are closer to the top-of-bank;

1930 - No changes from 1924;

1943 - No upland changes from 1930, though small pathways have been constructed at the lower terrace areas of the slope;

1944 - No changes from 1943;

1950 - Commencement of residential development in the area, including a small structure within the subject site and roadway development to the east;

1954 - Construction of additional residences in the area has occurred, and of the adjacent service road. Residential development upland to the east commenced, as had additional development to the northwest. No changes to the condition of the adjacent slope though a tall steep slope is observed to the northwest, clear of vegetation;

1962 - Upland park area to south of subject site cleared of vegetation with only grass remaining. Residential subdivision to east of Saskatchewan Drive generally

completed. Slope conditions remain relatively unchanged;

1965 - No changes from 1962, though construction of the residence to the immediate north;

1967 - No changes from 1965;

1969 - No changes from 1967;

1969 - Clearing of vegetation present from cul-de-sac to river edge along slope face (approximately 50 m south of subject site, utility installation). No other changes from 1967;

1971 - Clearing 50 m to south remains. No other changes from 1969;

1974- No changes from 1971;

1976 - Minor slumping of tall steep slope at 130 m to the northwest at the river edge

1978 - No changes from 1974 through clearing is partially re-vegetated;

1980 - 1990 No changes from 1978;

1995 - No changes from 1990, though upper portion of clearing is generally re-vegetated;

1997 - 2013 - No changes from 1995;

In summary, no slope instabilities or failures were noted in near vicinity of the subject site, with the only disturbance to the slope noted being:

1) the clearing extending down to slope face approximately 50 m south of the subject site in 1969 with the majority of this area since having vegetation restored; and
2) historical slumping of a tall steep slope at the river edge, about 130 m to the northwest of the subject site (identified as Location No. 1 on Drawing No. A-2, and discussed in Section 7.1.2).

Representation air photos showing historical site conditions are included in Appendix D.

5.2 REVIEW OF HISTORICAL COAL-MINING

Based on review of the following document, no coal mining activities have historically been present within the banks of the subject site:

"Atlas: Coal Mine Workings of the Edmonton Area."
Taylor, R., 1971. Published by Spence Taylor and Associates.

5.3 REVIEW OF CITY OF EDMONTON DOCUMENTS OF THE AREA

5.3.1 Instrumentation

No municipal instrumentation such as slope inclinometers (for monitoring of slope movements) have been installed in the area of the subject site.

5.3.2 Library Search

As part of our site study, the City of Edmonton Geotechnical Library was researched to identify publically available documents and previous studies, such to provide additional information of the area for comparative assessment to the site-specific information obtained for the subject property.

Six reports were identified in the City of Edmonton Library Register in proximity to the site, summarized as follows:

1) **Saskatchewan Drive and 84 Avenue and Saskatchewan Drive and University Avenue Slide Evaluations (EBA, July, 1991, and EBA, August, 1992)** - Review of the City of Edmonton Geotechnical Library indicates that there were two recent slope instabilities and repairs along

Saskatchewan Drive, at locations approximately 150 m (occurred in 1991) and 400 m (in 1992) south of the subject site. The areas are now characterized by the upper portion of the slope with only grass vegetation but clear of trees. The area near Saskatchewan Drive and 84 Avenue is indicated as Location No. 2 on Drawing No. A-1, Appendix A.

The studies completed for the two slope instabilities indicated that the characteristics and causes of the slope failure are similar in both cases, where the instability occurred along a shallow depth within the random, un-engineered fill materials placed on the slope surface of a previous drainage channel or local depression. The placement of the fill could also be related to a former roadway that had extended near the top-of-bank in the area.

The slope condition in the vicinity of the subject site is made of native ground without surficial fills with full vegetation with mature trees. As a result, the slope instability within the surficial fill materials as experienced in the two nearby locations, will very likely not occur in the close vicinity of the subject site because of the significant difference in the soil conditions along the slope surface.

2) **SubSurface Investigation - 1994 Additions 8606 Saskatchewan Drive by Omni-McCann (March, 1994) -** Completed for the residence within the subject site, such to provide geotechnical design recommednations for small additions on the west and south sides of the building.

3) **Slope Stability Evaluation - 8602 Saskatchewan Drive, Prepared by CT & Associates Engineering (August, 2009)** - Completed for slope assessment for residential re-development to the immediate south of the subject site, as discussed in Section 3.0 of this document.

No instabilities at the immediate vicinity of the subject site were identified.

4) **Geotechnical Top of Bank Assessment - 8634 Saskatchewan Drive, Prepared by EBA Engineering (June 2004)** - Completed for slope assessment for residential re-development for a property about 130 m to the north of the subject site, to identify risks and to present geotechnical site maintenance guidelines for the property. The report identifies known slope instabilities in the vicinity including as outlined in Item 1), above, and slumping at a property to its immediate north (8638 Saskatchewan Drive), below a recently installed pool, discussed below in Item 5).

5) **Geotechnical Assessment of Slumping Ground Conditions - 8638 Saskatchewan Drive, Prepared by Thurber Consultants (April, 1987)** - Completed for assessment of slumping below a pool (installed in 1967) located immediately at the top-of-bank, with active slumping below the pool being experienced. The slumping was considered related to seeping groundwater and freezing effects to the soils on this steep slope, with recommended horizontal drains to be installed and erosion matting be installed to minimize erosion.

6.0 FIELD INVESTIGATION

6.1 TOPOGRAPHY AND SURFACE FEATURES

A detailed review of the subject site, adjacent upland area, and adjacent slope conditions was completed on May 27, 2014.

The subject site is presented from the 2013 air photo for the area on Drawings No. A-1 and A-2, Appendix A, with site photographs presented in Appendix B.

6.1.1 Upland Area

The upland area of the subject site and its near vicinity is relatively flat with a gentle slope to the east. The site is now occupied by a single-storey residence with detached garage. Remaining areas are covered with grass and vegetation and a concrete driveway.

The properties to the immediate north and south is occupied by similar residential dwellings, while further to the south is a municipal park.

The lands to the east are occupied by a municipal service road and Saskatchewan Drive, with residential subdivision further to the east.

6.1.2 Adjacent Slope Area

Surface contours of the slope conditions in vicinity of the subject site are presented on Drawing No. A-2, Appendix A, with a typical profile of the slope adjacent to the site presented in Cross-Section "A-A", Drawing No. A-3, Appendix A.

The bank slope is about 50 m tall and is extensively covered with mature trees, shrubs and bushes, and is located along a gentle outside bend of the river valley.

The upper portion of the slope at the top-of-bank is approximately 1 (v) : 1.5 (h), extending to a relatively flat terrace area at approximately 40 m below the top-of-bank. The terrace area then extends horizontally for approximately 40 m to a steep slope (~1:1) that is approximately 6 m to 7 m tall that extends directly to the river.

The lower flat portion of the slope has several hiking trails that run parallel to the river.

Near the river edge and at the location of the clearing in the historical air photos, a sign was observed for an underground power line right-of-way extending along the clearing alignment. The location of the power line is indicated on Drawing No. A-1 (Location No. 1). The portion of the alignment over the lower flat portion of the slope was free of vegetation, through the upper portion (along the 1: 1.7 slope) was well-vegetated with mature tree growth.

Several isolated locations of bank erosion along the river edge were observed, (each less than 3 to 5 m long and in the order of 1 m to 2 m retrogression), typical of the Edmonton river valley and commonly observed at locations of small culvert pipes along the public walkways (thus creating concentrated flows). The river bank edge, where such erosion was observed is separated from the steeper portions of the slope by a 40 m wide relatively flat area with heavy and mature vegetation.

Additionally, about 130 m downstream of the subject site, some slumping of a tall steep (portion of the valley slope that extends directly to the river was observed (as indicated on Drawing No. A-2, Location No. 1), to be further discussed in Section 7.1.2.

Based on the site reconnaissance, the overall slope condition in vicinty of the subject site appears to be stable with only the isolated areas of erosion of the river bank edge observed.

6.2 SOIL CONDITIONS

To the east of the residence, surficial of topsoil and clay fill were encountered to about 0.8 m depth materials of topsoil was encountered, while to the west of the residence a clay fill was encountered to about 1 m depth, likely related to backfilling of the existing residence and landscaping.

Underlying the surficial organic and fill materials, there was a native medium to high plastic, moist clay extending to 4.5 m depth below the existing ground, overlying a thin wet silt layer (1.2 m thick).

Beneath the clay and silt deposit, a stiff to very stiff clay till deposit was encountered to approximately 18.5 m depth. Within the clay till, isolated moist, sand layers up to 0.6 m thick were encountered.

The clay till was then underlain by bedrock of clay shale and sandstone extending to the remaining depth of the borehole, (at the location of Borehole No. BH14-01 to 24 m depth and at the location of Borehole No. 09-01, 38.9 m below the ground surface).

Table 1 presents the generalized soil stratigraphy. Detailed descriptions of the soil conditions are presented on the borehole logs in Appendix C.

TABLE 1

GENERALIZED SOIL STRATIGRAPHY

Material	Soil Description	Approximate Depth to Top of Stratum (m)	Thickness of Stratum (m)	Approximate Elevation of Top of Stratum (m)
SURFACE MATERIALS	Topsoil - Organic, silty, sandy, some clay, moist, black Clay Fill - Silty, trace sand, trace organics, moist, medium to high plastic dark greyish brown	---	0.8 - 1.1	668.5
CLAY	Silty, trace sand, medium to high plastic, firm to stiff, moist, dark greyish brown	1.0	3.6	667.5
SILT	Clayey, trace sand, wet, non to low plastic, firm, dark greyish brown	4.4	1.2	664.1
CLAY TILL	Silty, sandy, trace coal and pebbles, moist, medium plastic, stiff to very stiff, dark greyish brown, occasional moist sand layers up to 0.6 m thick	5.6	13.2	662.9
BEDROCK	Clay Shale - Silty, trace sand, trace coal, damp, medium plastic, hard, dark grey Sandstone - Trace silt, trace clay, moist, fine-grained, uniform, very dense, non-plastic, grey	18.7	> 20	649.8

Note: Lower terrace of slope at approximately 623 m elevation, with river level at approx. 617 m elevation

6.3 GROUNDWATER CONDITIONS

One piezometer was installed for groundwater measurements. At the time of the installation, no water or sloughing was encountered at the borehole locations.

On May 27, 2014 (twenty-five days after piezometer installation), the groundwater level was measured, summarized in Table 2.

TABLE 2

SUMMARY OF PIEZOMETER INSTALLATION AND WATER TABLE READINGS

Piezo. Location	Piezo. Depth (m)	Intersected Lithology	Ground Elev. (m)	Depth to Water at Time of Installation (May 2, 2104) (m)	Groundwater Level Readings	
					May 27, 2014	
					Depth to Water (m)	Elev. (m)
BH14-01	23.6	Clay/Clay Till/Clay shale and Sandstone	668.5	Dry	11.6	656.9

The measured water level at the deep borehole is related to encountered moist to wet silt and sand (within the clay till) and not a physical groundwater level that exists within the bedrock at depth.

During the 2009 study of the adjacent lot, groundwater was measured at greater than 26 m depth.

7.0 SLOPE STABILITY & DEVELOPMENT SETBACK DISTANCE

The following potential mechanisms of ground movement were considered for evaluation of slope stability and determination of setback distances:

- Slope and toe erosion, and surficial slumping due to weathering of steep slopes due to natural processes and removal of vegetation;
- Human disturbance (changes in slope configuration, previous and future upland development, fill placement);
- Changes in groundwater conditions and surface drainage;
- Potential deep-seated slope failure through weak zones within bedrock at depth.

As a result, the final recommendations on the setback distance are based upon review of site and slope history including determination of erosion rates (slope crest and toe), site topography and encountered subsurface conditions, field observations of long-term slope behavior, local experience, and conservative theoretical analysis.

7.1 ASSESSMENT OF ADJACENT SLOPE INSTABILITIES

7.1.1 Slides to the South of the Subject Site

As outlined in Section 5.3.2, above, the two isolated slides to the south of the subject site (approximately 130 m to the south and 350 m south) were related to fill placement at these areas, from in-filling along the slope surface of a local drainage channel or a former roadway. Such a slope instability is likely to not occur in close vicinity of the subject site as such fill materials are not present in the property.

7.1.2 Observed Slumping to the North of the Subject Site

As outlined in Section 6.1.2, about 130 m downstream of the subject site, some slumping of a tall steep (portion of the valley slope that extends directly to the river was observed (as indicated on Drawing No. A-2, Location No. 2), was observed during the site review and historically identified during the air photo study.

The slope at this slumping area, about 15 m tall and at about a 1 : 1 slope angle, is this area extends directly to the river and is generally without much vegetation coverage. Back of this tall slope is a flat terrace area of the river valley (about 40 m wide), similar to that as below the subject site.

As such a tall steep slope does not existing below the subject site (the slopes adjacent to the subject site are significantly less tall and steep than this identified nearby location and covered with heavy tree and vegetation growth), such slumping will not occur below the area of the subject site.

7.2 EROSION EFFECTS & SURFACE SLUMPING

7.2.1 Natural Processes and Toe Erosion

Based on the historical air photo review (1924 through 2013), and the site reconnaissance of the slopes in near vicinity of the subject site, the majority of areas did not display any erosion or instabilities such as slumping or significant toe erosion (the toe of the slope is situated at a very gentle outside bend of the North Saskatchewan River). Practically no measurable rate of bank erosion could be determined over the past 70 years.

As observed during the site reconnaissance, some nearby recent slope instabilities (due to erosion and surface slumping) have been documented (as outlined in Section 7.1), though located within protected areas of the river valley parks system and thus maintained from significant retrogression.

It is concluded that based on the existing slope configurations and surface vegetation, no significant bank crest retrogression will occur in the future, provided that developments in the upland area are strictly controlled to protect the vegetation.

Additionally, toe erosion effects are estimated at less than 2 m over 70 years for the area and based on the presence of the relatively flat, heavily vegetated area that extends for approximately 45 m at the bottom of the slope, of practically no significance to the subject site.

7.2.2 Loss of Vegetation and Slope Surface Erosion

The upland area of the subject site is generally clear of heavy vegetation, thus there will be no loss of vegetation over the upland areas with development which could potentially affect slope conditions.

The slope area to the west of the site is part of the City of Edmonton municipal parks systems, and therefore protected from disturbance or removal.

Provided development at the site is controlled to not introduce concentrated surface water drainage toward the river, there will be no significant long term effects on the slope stability due to loss of vegetation or surface erosion.

7.3 HUMAN DISTURBANCE

The upland areas adjacent to the subject site is a developed residential subdivision, with mature trees and surface vegetation.

Provided development at the site is controlled to not introduce concentrated surface water drainage toward the slope crest, there will be no significant long term effects on the slope stability due to the upland development at the subject site.

For long-term slope protection, all existing vegetation over the slope face should remain and not be disturbed.

7.4 ASSESSMENT OF GROUNDWATER CONDITIONS

The upland areas in vicinity of the development site has been residential development for over 50 years. Any potential effects of hydraulic changes in the thick clay and clay till underlying the subject site from the upland development, have already occurred and any future effects will be minimal. There is no seepage observed over the slope face.

In view of the development history already present over the upland areas and the local thick clay over bedrock soil conditions, there is practically no potential for significant increases in shallow groundwater conditions which could impact slope conditions.

However, for conservative considerations, a raised groundwater table of 2 m is included in the slope stability analysis.

7.5 DEEP-SEATED FAILURE

Based on the existing slope configurations in relation to the soil stratigraphy consisting of approximately 18 m of clay, sand, and clay till deposits overlying bedrock of sandstone and clay shale, with a greater than 10 m thick clay till layer between the moist to wet sand and bedrock below, it is unlikely that a deep-seated failure would occur through long term weakening of the bedrock at depth.

However, for conservative analysis, a weakened bedrock (thus producing a slip surface within the slope at the clay till/bedrock interface), is considered in the slope stability analysis.

7.6 SLOPE STABILITY ANALYSIS & DEVELOPMENT SETBACK DISTANCE

Based on the above considerations, slope stability analysis to determine development set-back distances were conducted on the representative slope cross-section profile "A-A" (Drawing No. A-3, Appendix A), with appropriate soils strength parameters including weakened bedrock, as well as raised groundwater levels (though unlikely).

Details of the slope analysis are presented in Appendix E.

The development and building set-back is shown on Drawing No. A-4, Appendix A.

The Building set-back line (BLL) is defined as the minimum distance for which any building structure construction (including attached decks) can approach the top-of-bank, whereas the Development Set-Back (DLL) is the limit that any site work (grading or landscaping, fill placement) can approach the top-of-bank.

Areas between the Top-of-Bank and Development Limit Line should be maintained and protected, with only minor landscape work (no structures, grading, of fill placement)

permitted. Between the Development and Building Limit Lines, minor surface work (landscaping) and minor fill placement (less than 0.6 m) is permitted, though should be minimized as much as possible.

8.0 DEVELOPMENT GUIDELINES AND FOUNDATION DESIGN PARAMETERS

Based on the geotechnical evaluation conducted, the site is considered as a good site suitable for the proposed housing construction. The following construction guidelines should be followed.

8.1 DEMOLITION OF EXISTING STRUCTURE

Upon demolition of the existing structure all engineered fill materials should consist of low to medium clay soils (not granular materials) compacted to 98% Standard Proctor Density, to prevent surface water penetration. In addition, grading in the area of the building demolition as well as those along the top-of-bank area should be graded to minimize concentrated surface drainage and to provide positive drainage away from the bank crest, wherever practical.

Periodic monitoring of slope conditions during demolition and backfilling should be conducted by CT & Associates Engineering Inc. to ensure no impacts to the existing slope conditions.

8.2 BUILDING AND SITE DEVELOPMENT

With site re-development, the overall topography of the subject should not be altered significantly. Areas between the Development Limit Line and Building Limit Line should

be completed with landscaping (with no gravel placement) and with no other work completed.

Grading of the new residence should be completed to provide positive drainage away from the top-of-bank, wherever practical, with no concentrated flows towards the top-of-bank created. Additionally, no significant fill placement (less than 0.6 m and with none back of the Development Limit Line) should be included as part of site work.

The location of proposed building structure (including attached decks) should meet the building setback criteria as defined on Drawing A-4, Appendix A.

8.3 WATER RETENTION PONDS AND SPRINKLER SYSTEMS

No water retention ponds, swimming pools, fish ponds, or similar water retention facilities should be constructed within the property.

Additionally, underground sprinkler systems should not be installed on the property.

8.4 GEOTHERMAL SYSTEM

No geothermal system should be installed on the property. The geothermal system could consist of buried horizontal pipes and/or drilled vertical pipes of 30 to 100 m in length. By nature of the system, any water leakage from the system would have negative effect on subsurface groundwater conditions and slope stability.

8.5 UNDERGROUND SERVICES

The underground services such as sewer and water lines should be adequately designed and installed by contractors whose activities can be inspected and monitored by the City of Edmonton's inspector.

8.6 LOT GRADING

The existing topography generally slopes towards the top-of-bank. In order to maintain the slope stability, no increased surface drainage should be allowed toward the slope. As a result, the following provisions should be made:

.1 The existing vegetation between the Top-of-Bank and Development Limit Line should remain and not be disturbed for slope protection, with only restoration of surface vegetation;

.2 All roof leaders and weeping tile for the building should be connected directly to storm sewers;

.3 The topography and vegetation of the front and back yard should not be adversely altered to induce concentrated surface flow towards the slope. During the various stages of the development, temporary grading should be provided to minimize concentrated surface drainage flow towards the slopes;

.4 Landscaping that includes significant gravel/rock placement should not be placed in the rear yard area of the lot such to minimize surface water drainage into concentrated flow over the slope.

CT & Associates Engineering Inc. should be given an opportunity to review design drawings prior to finalizing, to ensure the required set-back distances and slope protection parameters are provided.

8.7 FOUNDATION DESIGN PARAMETERS

The following parameters are recommended for foundation design:

.1 Strip and spread footings founded on undisturbed native clay - 100 kPa. The exposed bearing surface for footing construction should be inspected by CT & Associates to ensure a suitable bearing surface has been provided.

.2 Cast-in-place concrete friction piles:

Depth below existing grade(m)	Allowable Skin Friction (kPa)
0 - 2.0	0
> 2.0	25

The minimum pile length is 6 m, with reinforced steel in the upper 5 m of pile shafts. Void forms should be provided beneath all grade beams or pile caps to prevent excessive uplift loadings resulting from frost heaving or soil swelling due to moisture increase.

8.8 CEMENT TYPE

Two soil samples were tested for water soluble sulphate concentrations. The test results were both less than 0.01% (by weight), indicating the degree of sulphate attack on concrete is negligible.

As such, Type GU (10) Portland Cement, is suitable for all concrete elements. Air entrainment of 4% to 6% by volume is recommended for all concrete exposed to freezing temperatures and/or native soils.

9.0 CLOSURE

This report has been prepared in accordance with generally accepted geotechnical practices and procedures.

Classification of soil and groundwater conditions within the report have been based on generally accepted engineering practices in this area. Conditions identified during the field work, and thereby recommendations presented within this report are considered to be reasonably representative of the site. If however, conditions other than those presented are identified during any other work on the subject property, CT & Associates Engineering Inc. should be notified, and given an opportunity to review or modify our recommendations in light of new findings.

APPENDIX A

DRAWINGS

NOTES:

1. Site topography based on City of Edmonton Air Photo (2013).
2. Approximate Scale 1:2,000

APPROXIMATE SCALE (meters)

0 40 80

CTA CT & ASSOCIATES ENGINEERING INC.				PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT: LOUIS CSABA				TITLE: SITE LOCATION AND AIR PHOTO	
DATE: May 26, 2014	DWN.: DSN	CHKD.: CTH		FILE NO.: 02-1781-A1	DWG. NO.: A-1

NOTES:

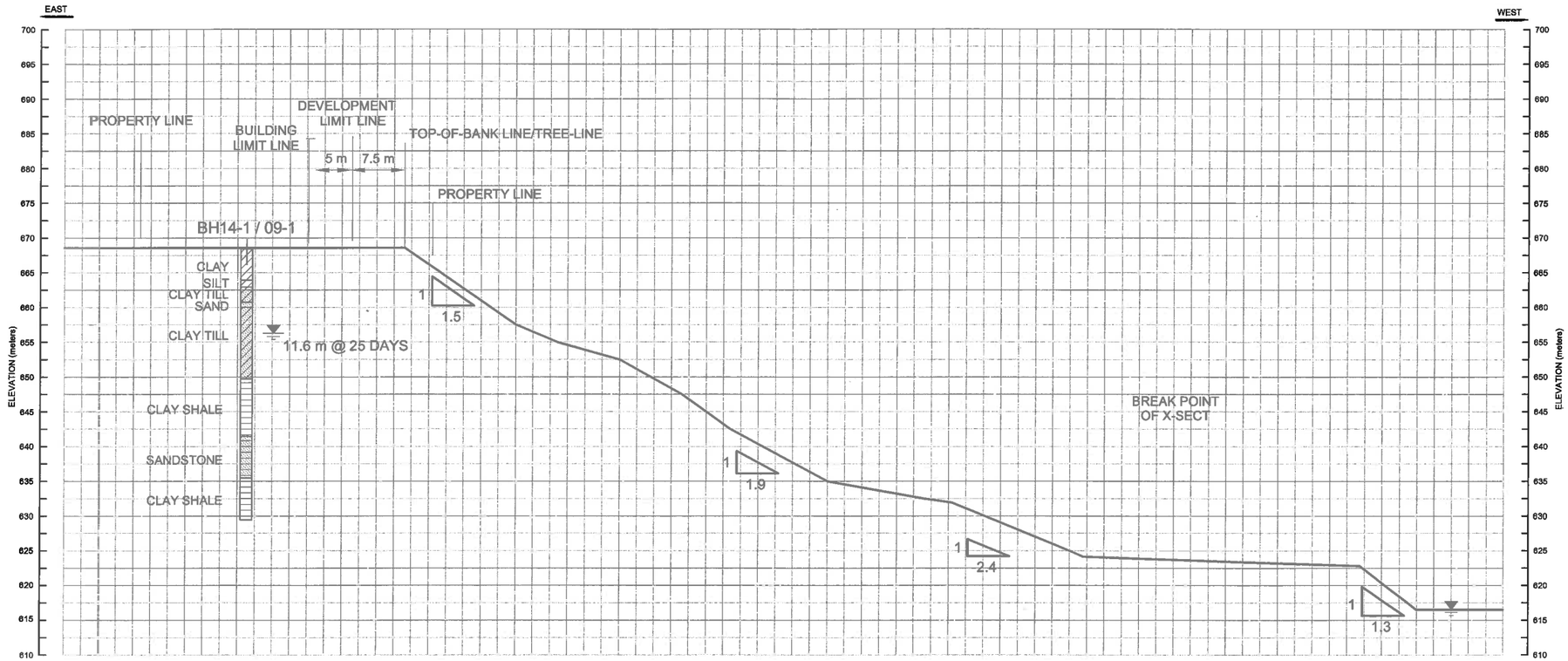
1. Site topography based on City of Edmonton Air Photo (2013).
2. Approximate Scale 1:2,000
3. Contour interval = 0.5 m

APPROXIMATE SCALE (meters)

0 40 80

CT & ASSOCIATES ENGINEERING INC.				PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT: LOUIS CSABA				TITLE: SITE CONTOURS & BOREHOLE LOCATIONS	
DATE: May 26, 2014	DWN.: DSN	CHKD.: CTH		FILE NO.: 02-1781-A2	DWG. NO.: A-2

CROSS-SECTION A-A (LOOKING SOUTH)



NOTES:

1. Site topography based on Site survey and City of Edmonton contour plan (2002).
2. Subsurface soil conditions have been based on borehole information.
3. Location of Cross-Section is shown on Drawing No. A-2.

APPROXIMATE SCALE (meters)

0 15 30

CT & ASSOCIATES ENGINEERING INC.				PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT: LOUIS CSABA				TITLE: CROSS-SECTION A-A (LOOKING SOUTH)	
DATE: MAY 26, 2014	DWN.: DSN	CHKD.: CTH		FILE NO.: 02-1781-A3	DWG. NO.: A-3

APPROXIMATE SCALE (meters)

0 10 20

NOTES:

1. Site topography based on City of Edmonton Air Photo (2013).
2. Approximate Scale 1:500
3. Contour interval = 0.5 m

CT & ASSOCIATES ENGINEERING INC.				PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT: LOUIS CSABA				TITLE: TOP-OF-BANK AND SET-BACK DEFINITIONS	
DATE: May 26, 2014	DWN.: DSN	CHKD.: CTH		FILE NO.: 02-1781-A4	DWG. NO.: A-4

APPENDIX B

SITE PHOTOS

Photo 1: Slope adjacent to subject site (looking east from west side of river).

Photo 2: Existing residence at subject site.

Photo 3: Typical slope and vegetation conditions.

Photo 4: Typical riverbank conditions.

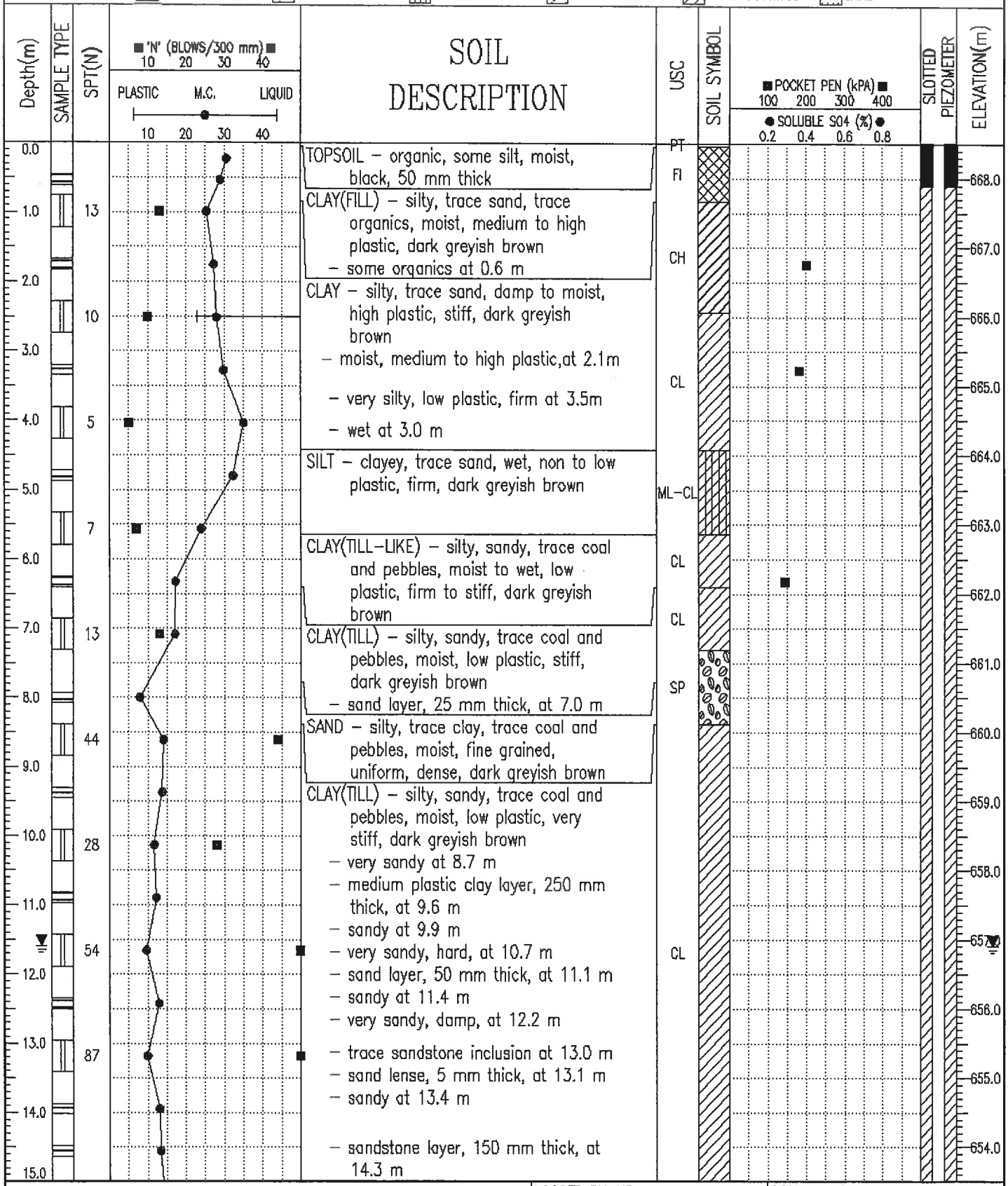
APPENDIX C

BOREHOLE LOGS

SLOPE STABILITY ASSESSMENT	LOUIS CSABA	BOREHOLE NO: BH14-01
8606 SASKATCHEWAN DRIVE, EDMONTON, AB	B-61 TRUCK MOUNTED DRILL RIG	PROJECT NO: 02-1781
LOT 2, BLOCK A, PLAN 2010HW	SOLID STEM AUGER	ELEVATION: 668.50 m

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



C.T. & Associates Engineering Inc.

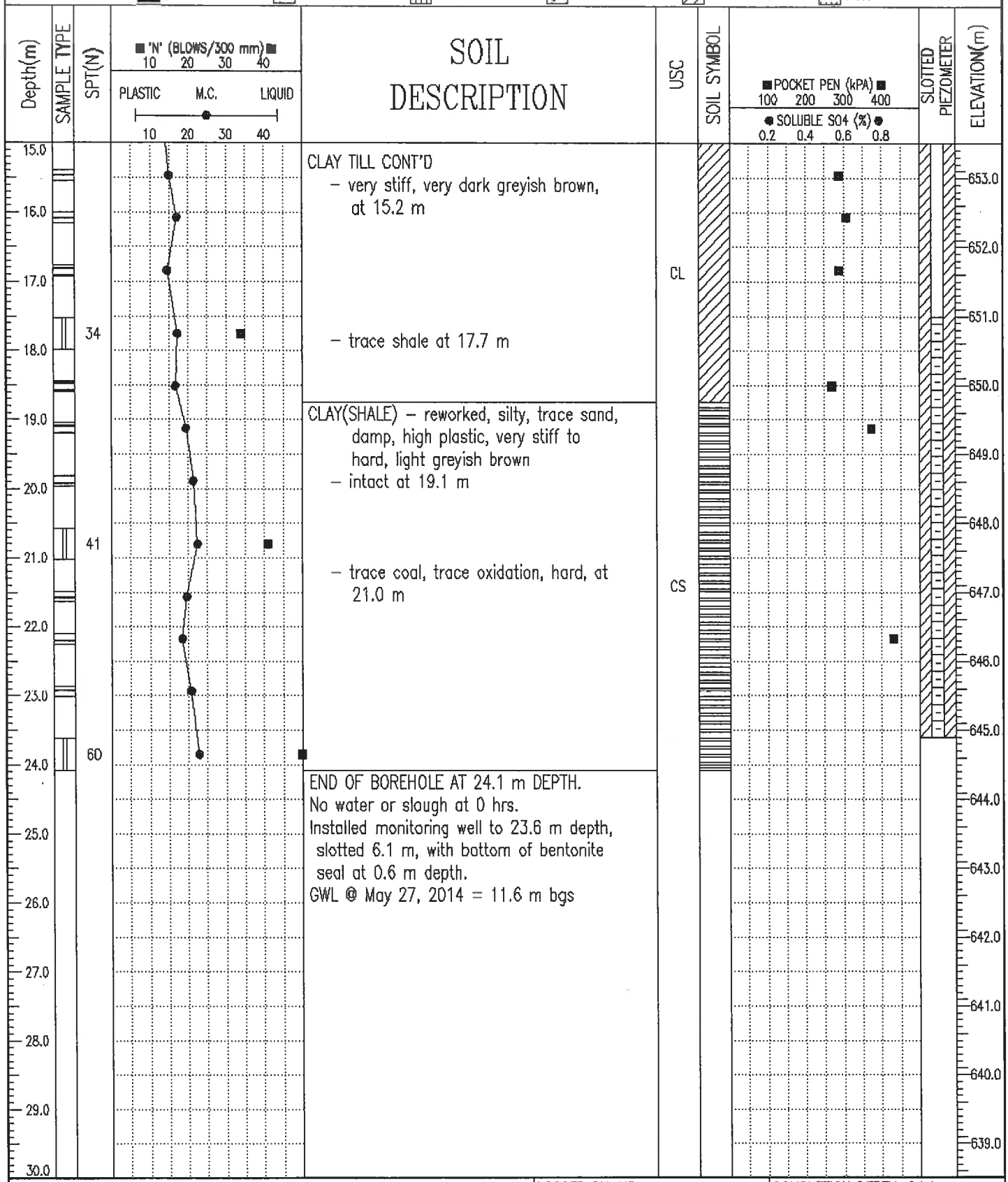
LOGGED BY: NR	COMPLETION DEPTH: 24.1 m
REVIEWED BY: DSN	COMPLETE: 02/05/14
Fig. No: B-1	Page 1 of 2

14/05/29 11:51AM (GEOELEV)

SLOPE STABILITY ASSESSMENT	LOUIS CSABA	BOREHOLE NO: BH14-01
8606 SASKATCHEWAN DRIVE, EDMONTON, AB	B-61 TRUCK MOUNTED DRILL RIG	PROJECT NO: 02-1781
LOT 2, BLOCK A, PLAN 2010HW	SOLID STEM AUGER	ELEVATION: 668.50 m

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



CLAY TILL CONT'D
- very stiff, very dark greyish brown, at 15.2 m
- trace shale at 17.7 m

CLAY(SHALE) - reworked, silty, trace sand, damp, high plastic, very stiff to hard, light greyish brown
- intact at 19.1 m
- trace coal, trace oxidation, hard, at 21.0 m

END OF BOREHOLE AT 24.1 m DEPTH.
No water or slough at 0 hrs.
Installed monitoring well to 23.6 m depth, slotted 6.1 m, with bottom of bentonite seal at 0.6 m depth.
GWL @ May 27, 2014 = 11.6 m bgs

C.T. & Associates Engineering Inc.

LOGGED BY: NR	COMPLETION DEPTH: 24.1 m
REVIEWED BY: DSN	COMPLETE: 02/05/14
Fig. No: B-1	Page 2 of 2

14/05/29 11:51AM (BEDELEY)

SLOPE STABILITY ASSESSMENT	LOUIS CSABA	BOREHOLE NO: BH14-02
8606 SASKATCHEWAN DRIVE, EDMONTON, AB	HAND AUGER	PROJECT NO: 02-1781
LOT 2, BLOCK A, PLAN 2010HW		ELEVATION: 668.50 m

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	SAMPLE TYPE	SPT(N)	"N" (BLOWS/300 mm) 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	SOIL DESCRIPTION	USC	SOIL SYMBOL	POCKET PEN (kPA) 100 200 300 400 / SOLUBLE SO4 (%) 0.2 0.4 0.6 0.8	INSTRUMENTATION DATA	ELEVATION(m)
0.0				TOPSOIL – organics, some sand, black, 50 mm thick – clay to some clay at 0.2 m	PT				668.5
				CLAY(FILL) – some silt, some organics, trace sand, moist, dark greyish brown to black	FI				668.0
1.0				CLAY – some silt, trace sand, moist to wet, medium to high plastic, firm, dark greyish brown	CH				
				END OF BOREHOLE AT 1.5 m DEPTH.					667.0
2.0									666.0
3.0									665.0
4.0									664.0
5.0									663.0
6.0									

C.T. & Associates Engineering Inc.

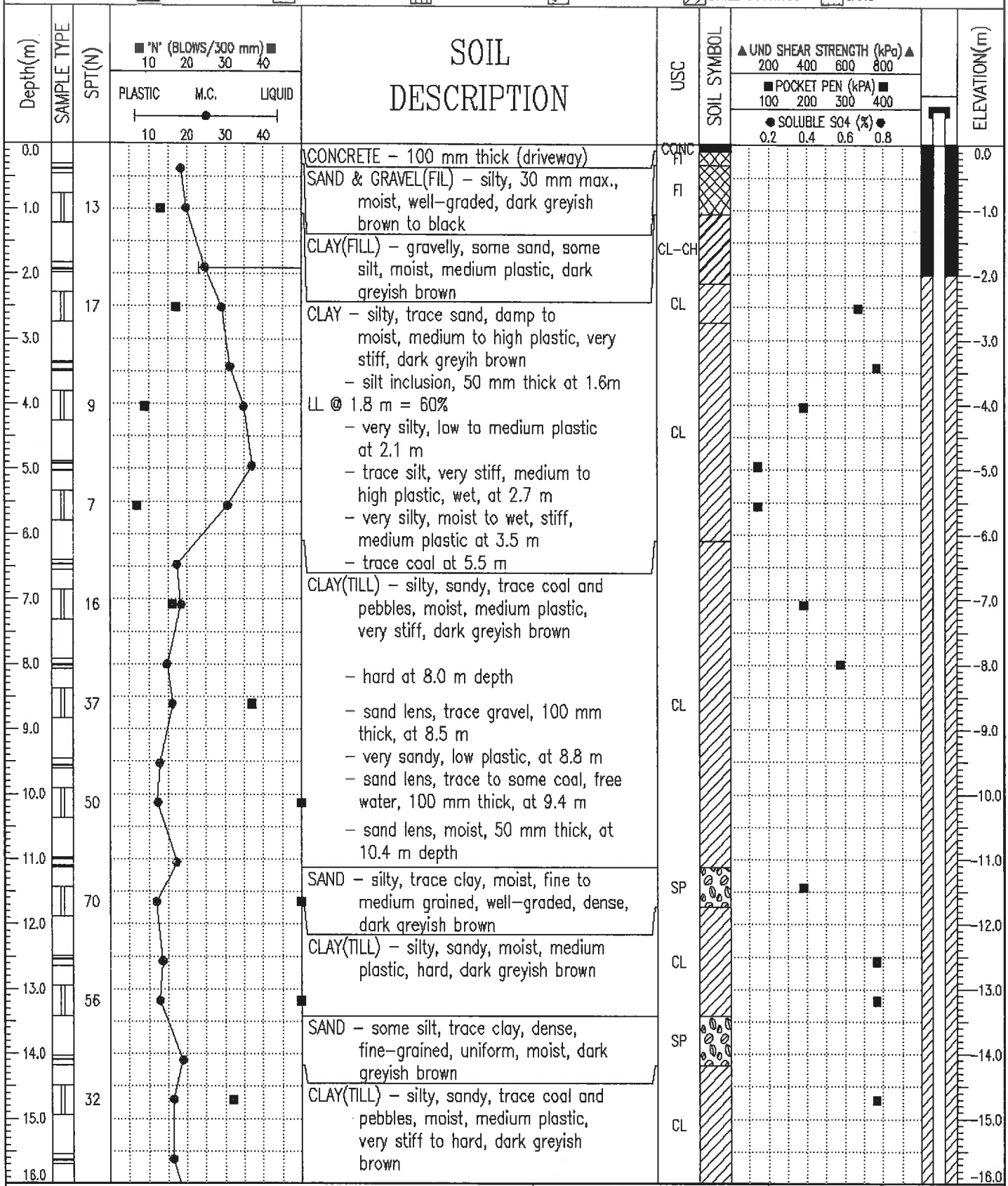
LOGGED BY: NR	COMPLETION DEPTH: 1.5 m
REVIEWED BY: DSN	COMPLETE: 27/05/14
Fig. No: B-2	Page 1 of 1

14/05/29 11:45AM (GEOELEV)

SLOPE STABILITY EVALUATION	LOUIS CSABA	TEST HOLE NO: BH09-1
8602 SASKATCHEWAN DRIVE	B-61 TRUCK MOUNTED DRILL RIG	PROJECT NO: 02-987
EDMONTON, ALBERTA	SOLID STEM AUGER	ELEVATION:

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



C.T. & Associates Engineering Inc.

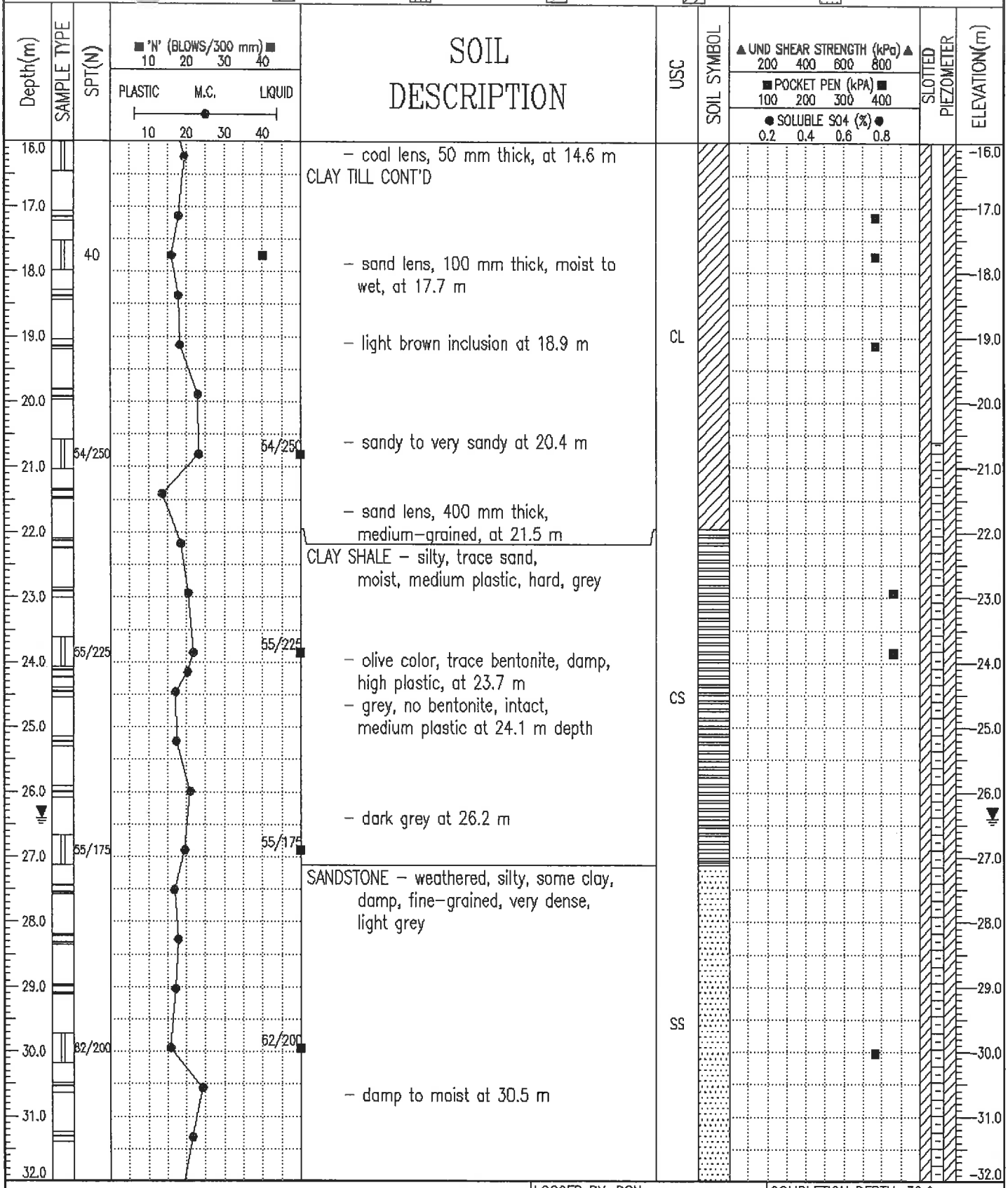
LOGGED BY: DSN	COMPLETION DEPTH: 38.9 m
REVIEWED BY: DSN	COMPLETE: 06/29/09
Fig. No: B-1	Page 1 of 3

14/05/29 11:28AM (BE01)

SLOPE STABILITY EVALUATION	LOUIS CSABA	TEST HOLE NO: BH09-1
8602 SASKATCHEWAN DRIVE	B-61 TRUCK MOUNTED DRILL RIG	PROJECT NO: 02-987
EDMONTON, ALBERTA	SOLID STEM AUGER	ELEVATION:

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



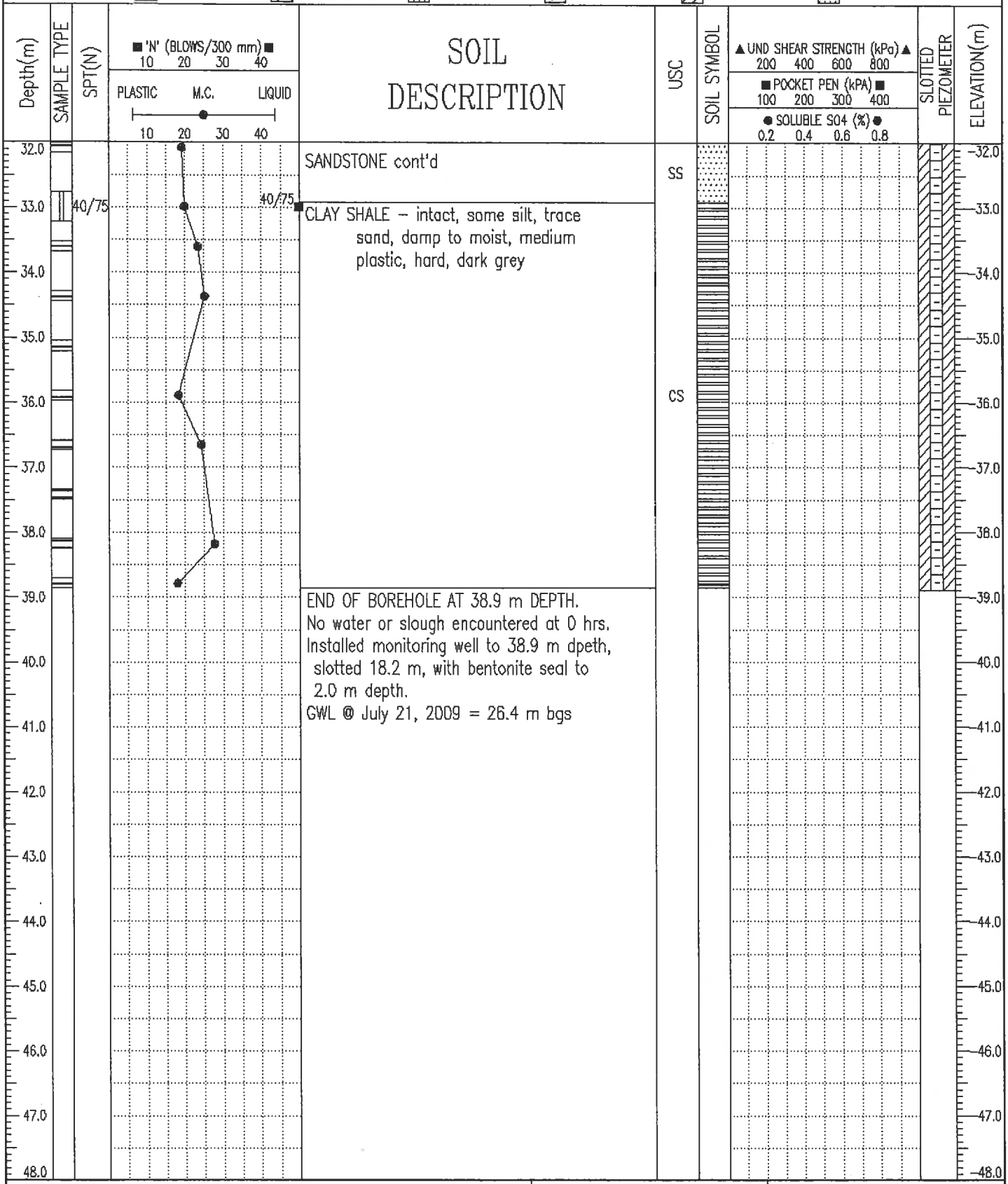
C.T. & Associates Engineering Inc.	LOGGED BY: DSN	COMPLETION DEPTH: 38.9 m
	REVIEWED BY: DSN	COMPLETE: 06/29/09
	Fig. No: B-1	Page 2 of 3

14/05/29 11:28AM (SE01)

SLOPE STABILITY EVALUATION	LOUIS CSABA	TEST HOLE NO: BH09-1
8602 SASKATCHEWAN DRIVE	B-61 TRUCK MOUNTED DRILL RIG	PROJECT NO: 02-987
EDMONTON, ALBERTA	SOLID STEM AUGER	ELEVATION:

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



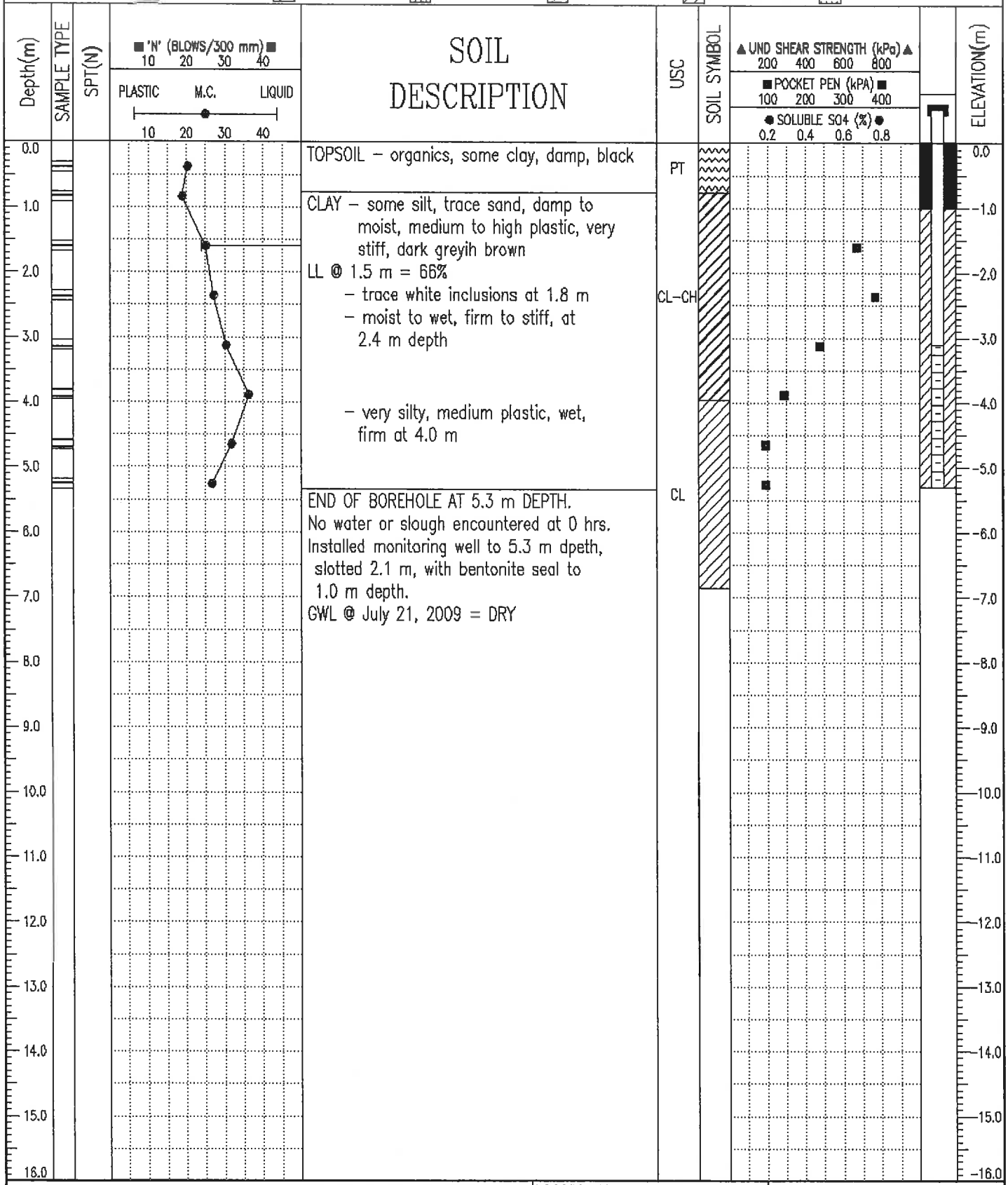
C.T. & Associates Engineering Inc.	LOGGED BY: DSN	COMPLETION DEPTH: 38.9 m
	REVIEWED BY: DSN	COMPLETE: 06/29/09
	Fig. No: B-1	Page 3 of 3

14/05/29 11:28AM (GE01)

SLOPE STABILITY EVALUATION	LOUIS CSABA	TEST HOLE NO: BH09-2
8602 SASKATCHEWAN DRIVE	B-61 TRUCK MOUNTED DRILL RIG	PROJECT NO: 02-987
EDMONTON, ALBERTA	SOLID STEM AUGER	ELEVATION:

SAMPLE TYPE: CORE | A CASING | NO RECOVERY | DISTURBED | SPT | SHELBY TUBE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



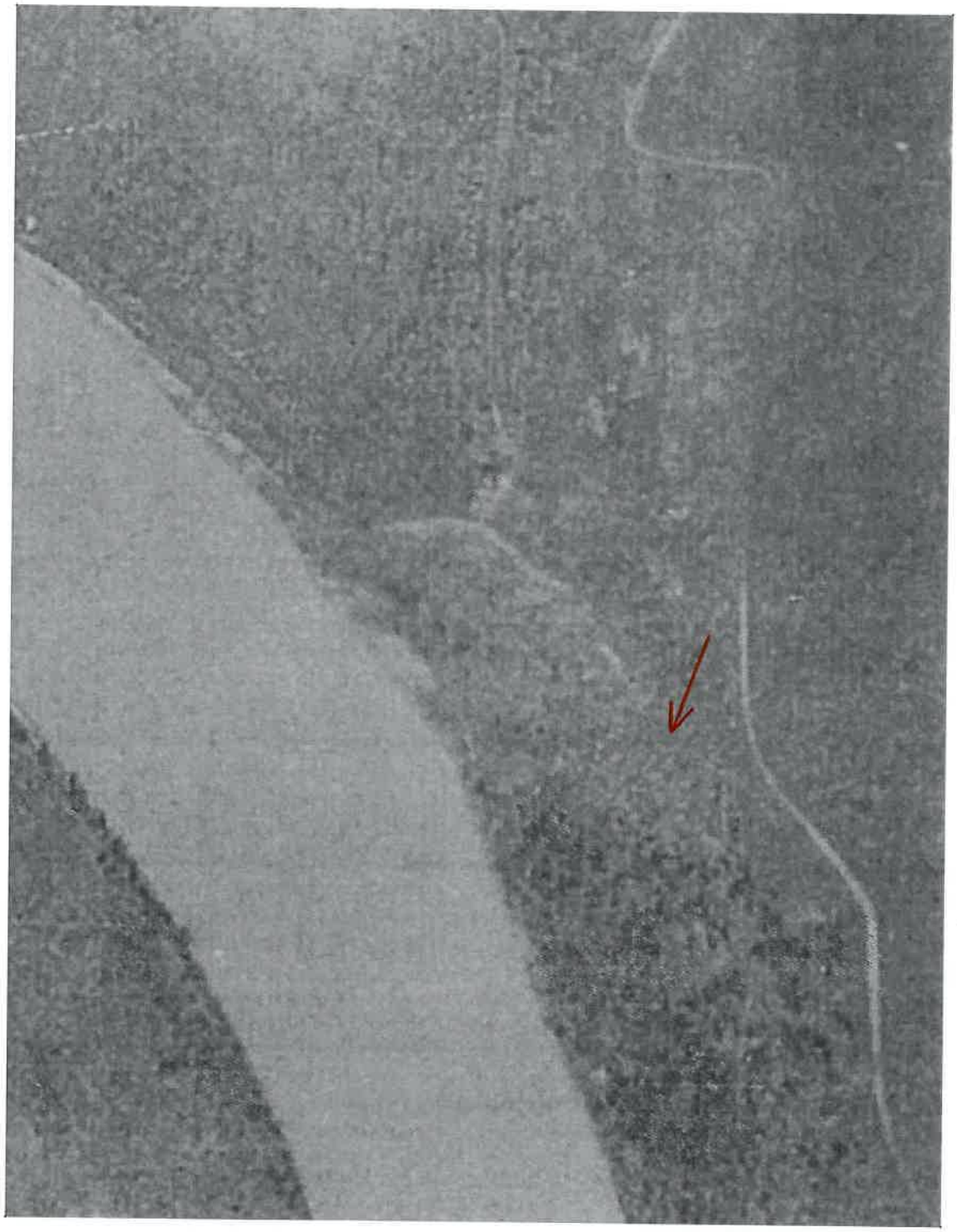
C.T. & Associates Engineering Inc.

LOGGED BY: DSN	COMPLETION DEPTH: 5.3 m
REVIEWED BY: DSN	COMPLETE: 06/29/09
Fig. No: B-2	Page 1 of 1

14/05/29 11:28AM (GE01)

APPENDIX D

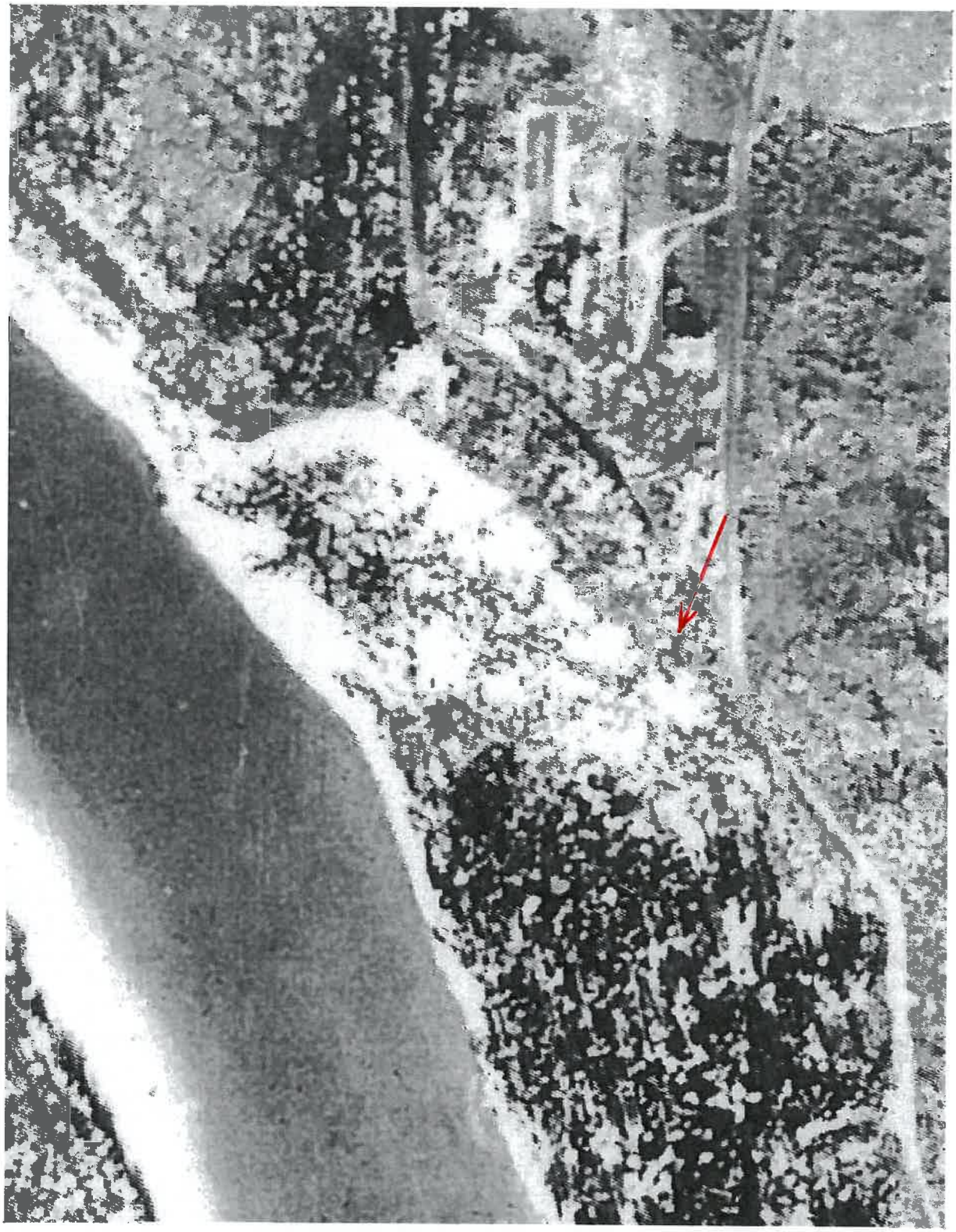
HISTORICAL AIR PHOTOS



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1924)

APPROXIMATE SCALE 1 : 2 500

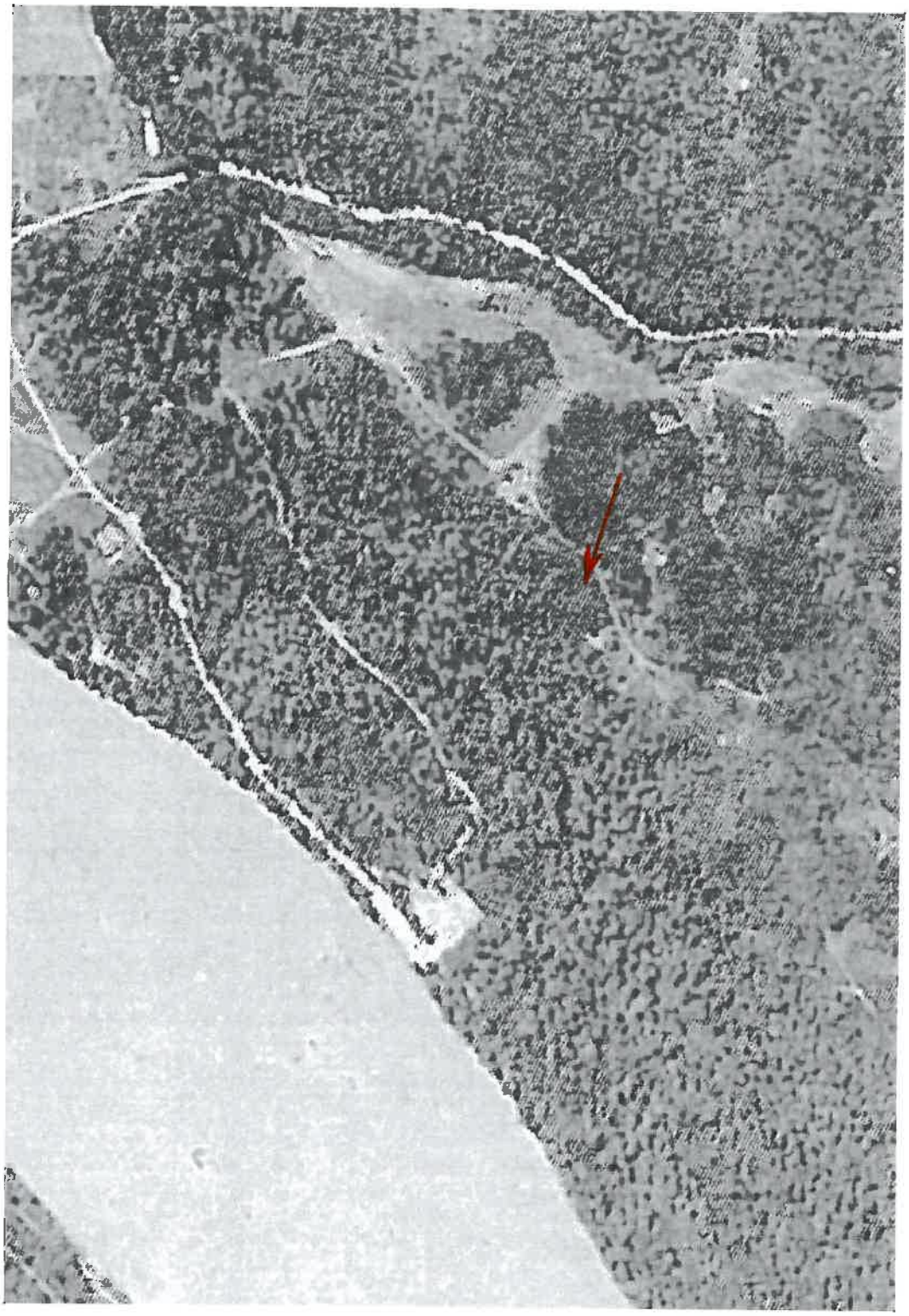
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1924		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C1	DWG. NO.: C-1	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1930)

APPROXIMATE SCALE 1 : 2 500

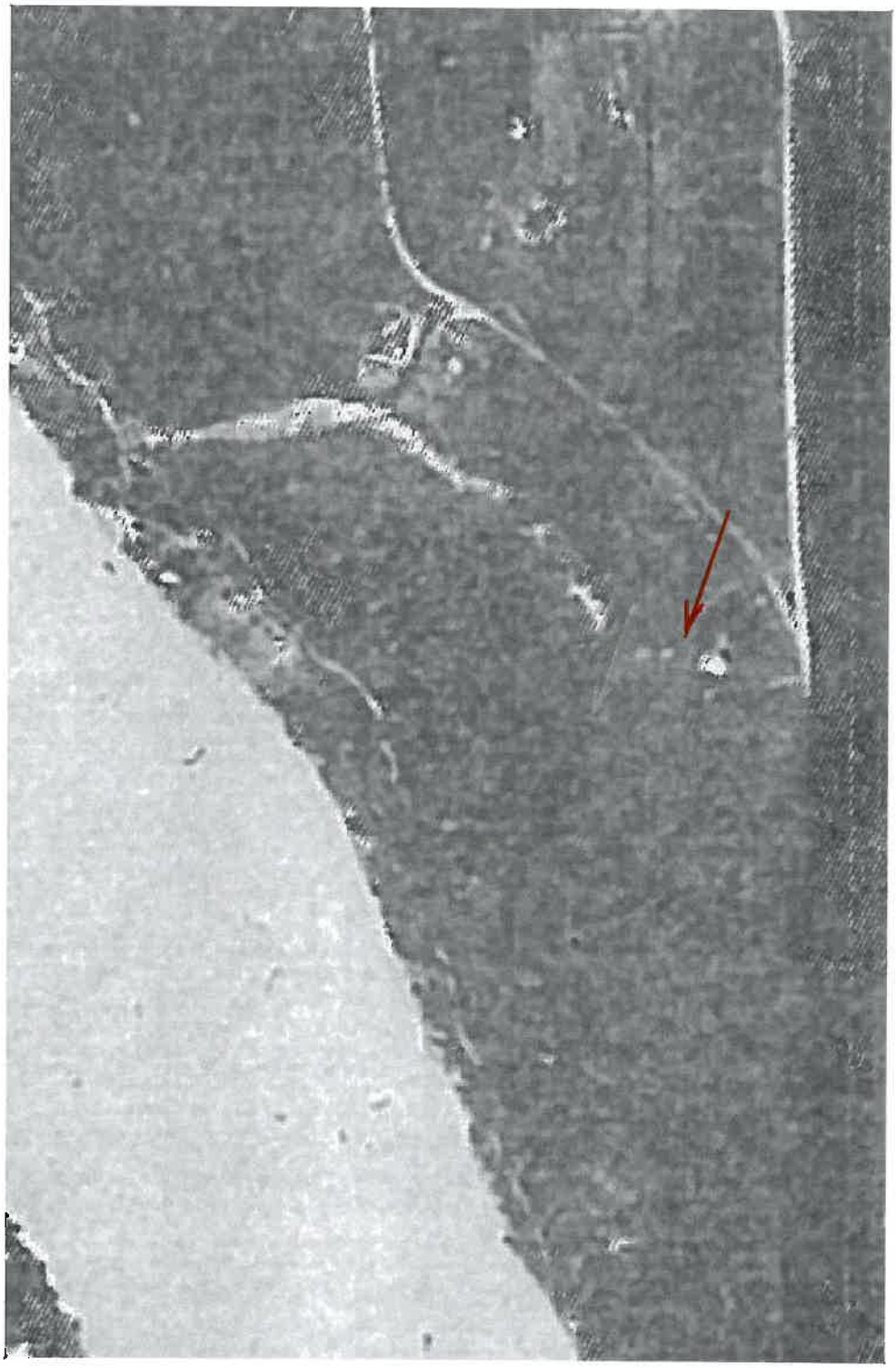
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1930		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C2	DWG. NO.: C-2	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1943)

APPROXIMATE SCALE 1 : 2 500

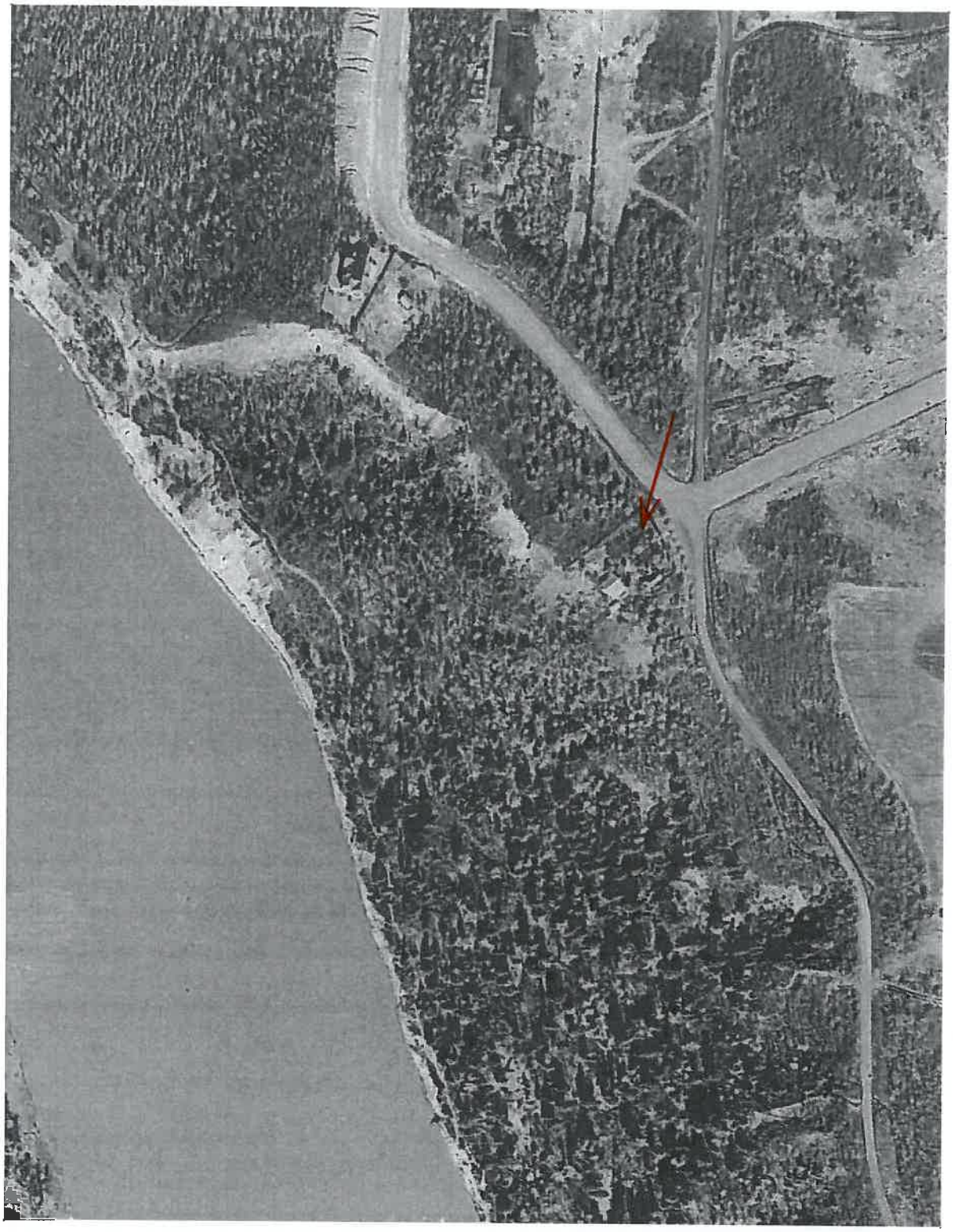
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1943		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C3	DWG. NO.: C-3	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1944)

APPROXIMATE SCALE 1 : 2 500

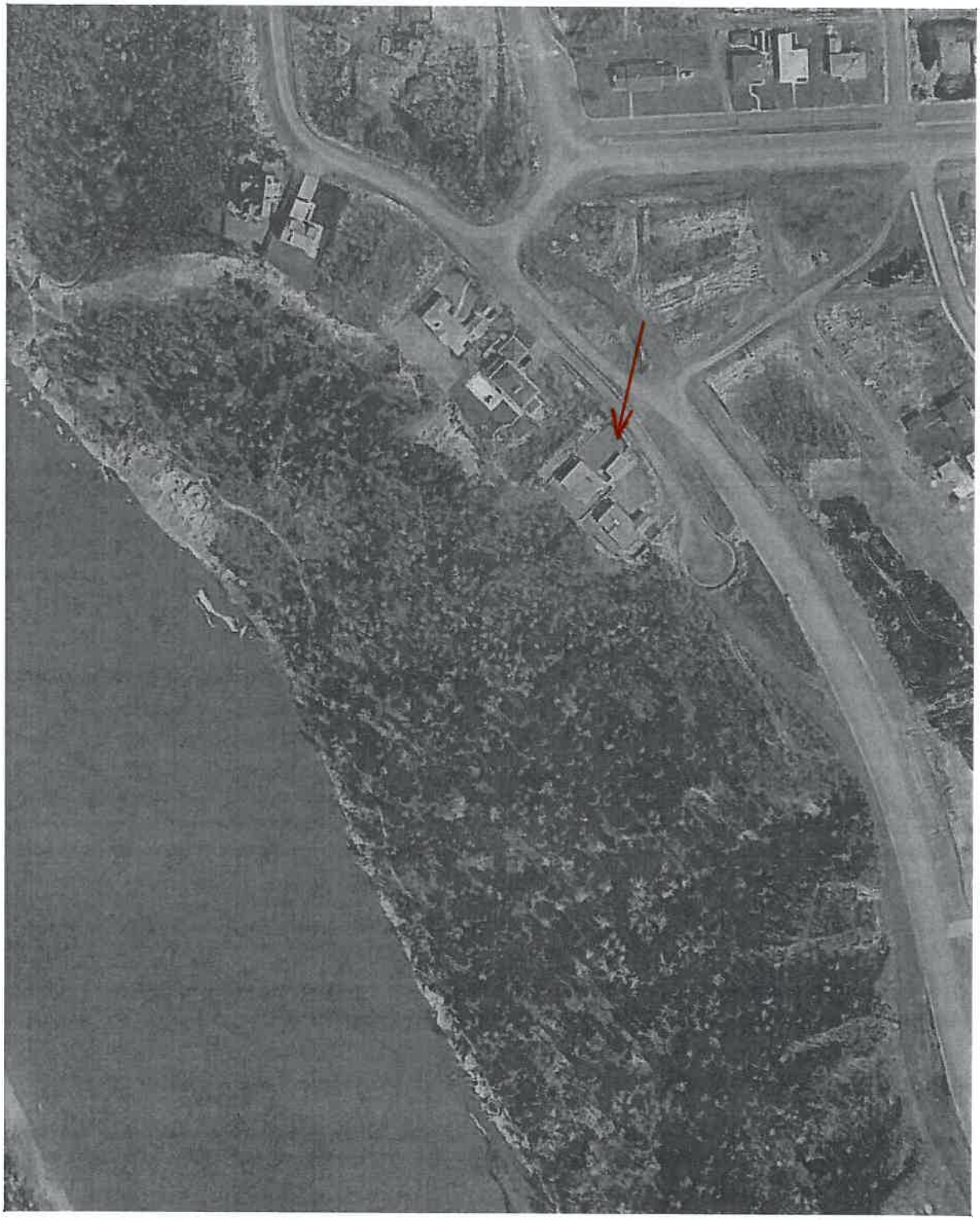
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1944		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C4	DWG. NO.: C-4	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1950)

APPROXIMATE SCALE 1 : 2 500

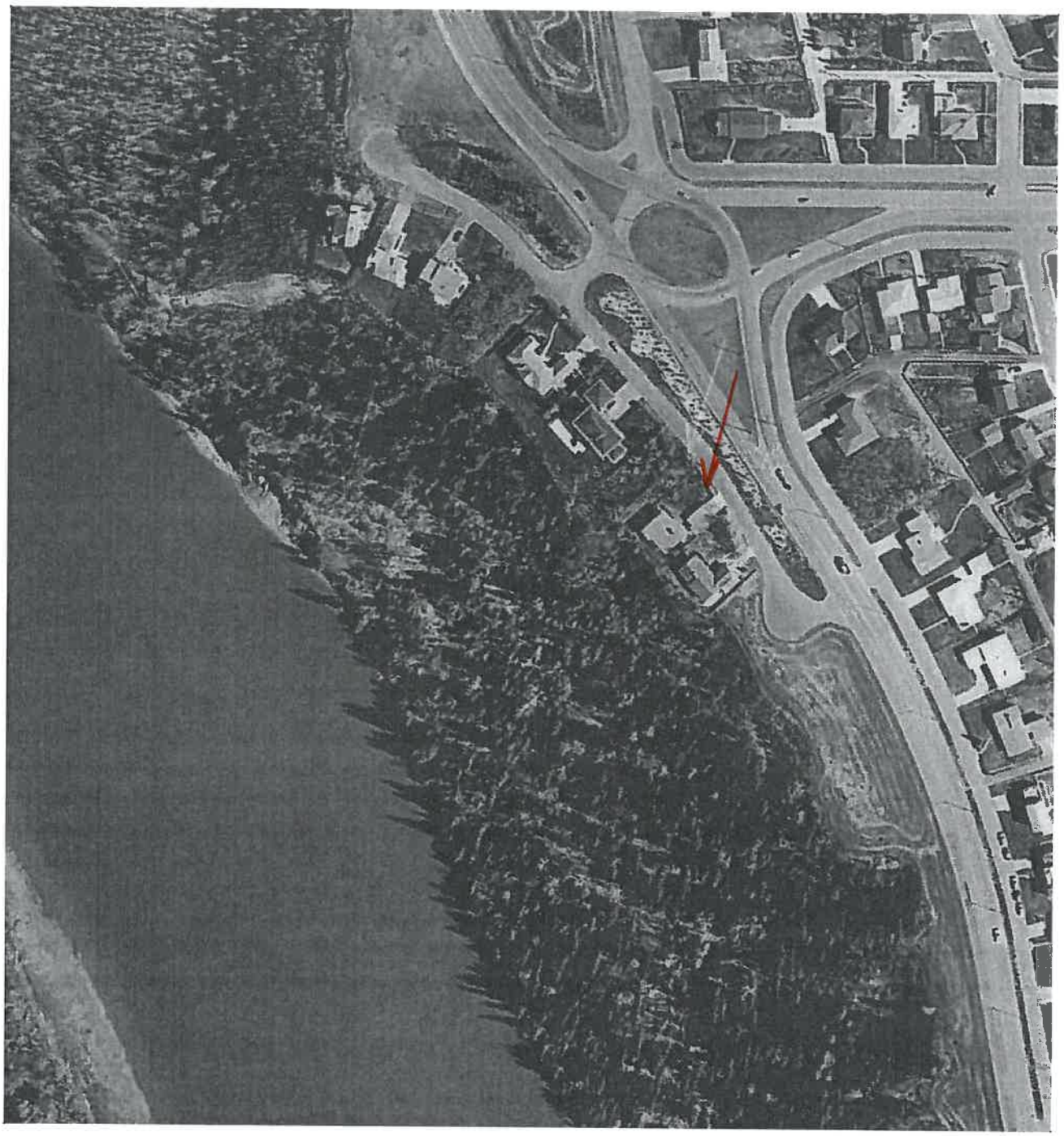
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1950		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C5	DWG. NO.: C-5	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1954)

APPROXIMATE SCALE 1 : 2 500

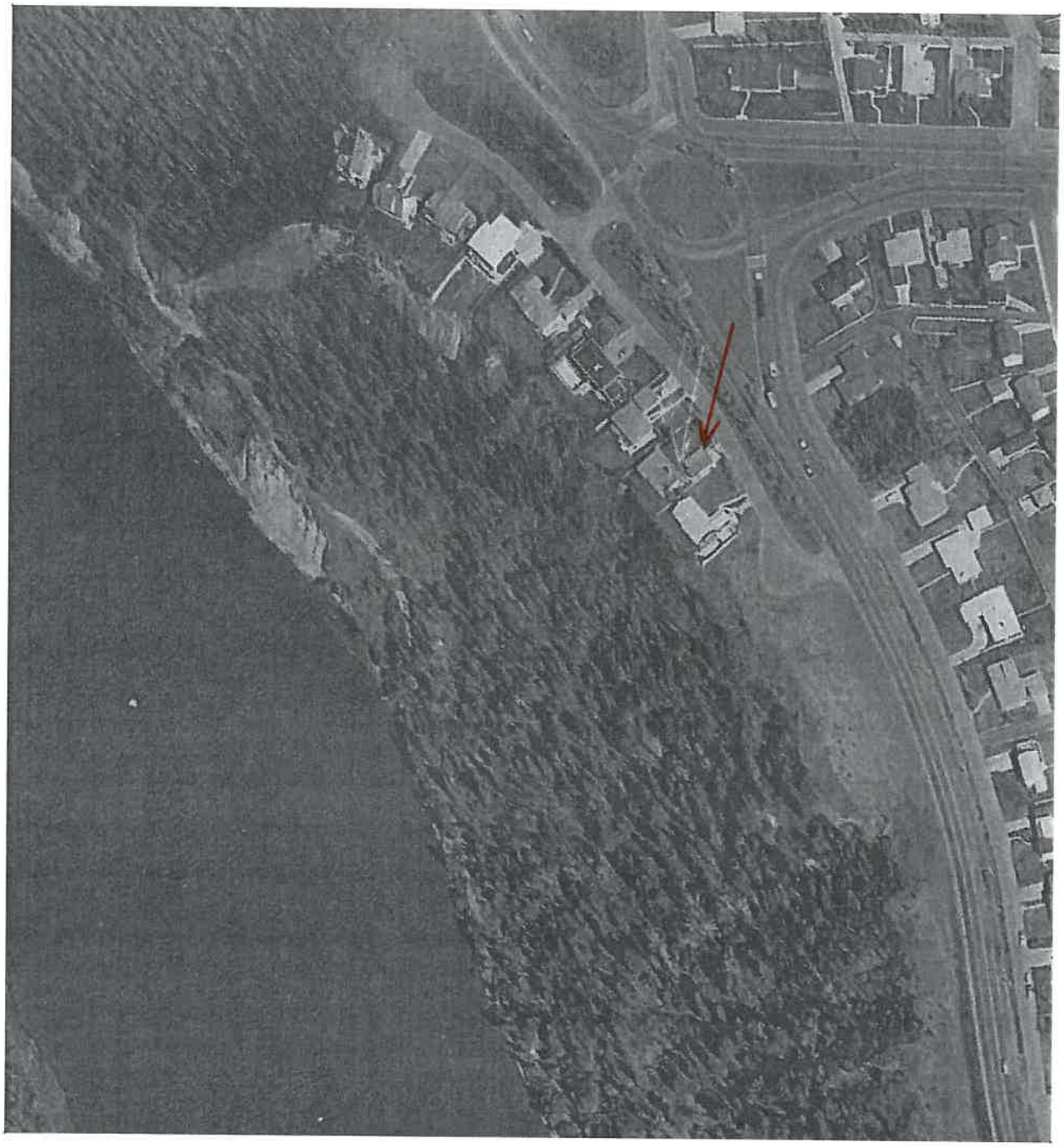
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1954		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C6	DWG. NO.: C-6	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1962)

APPROXIMATE SCALE 1 : 2 500

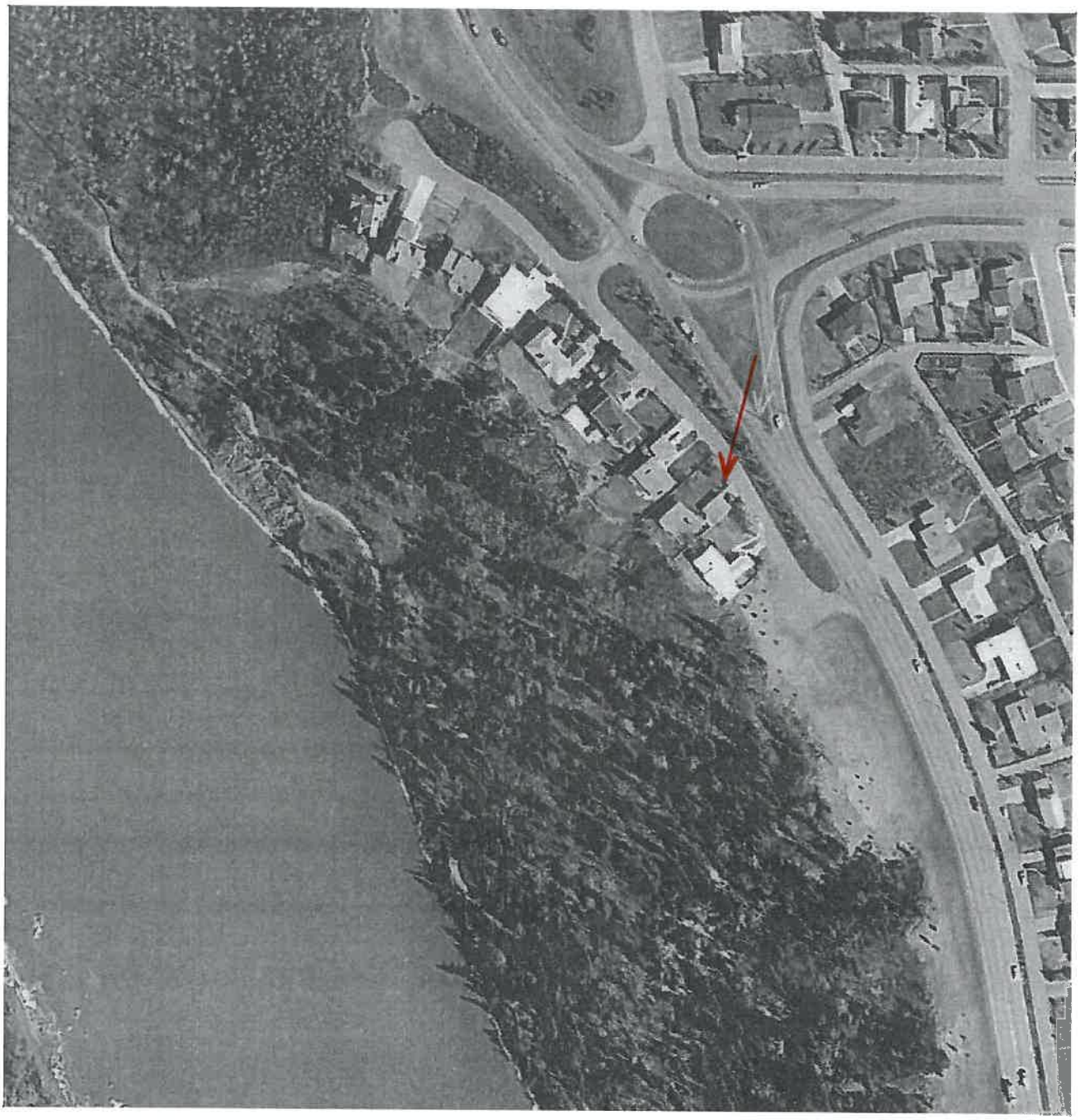
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1962		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C7	DWG. NO.: C-7	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1965)

APPROXIMATE SCALE 1 : 2 500

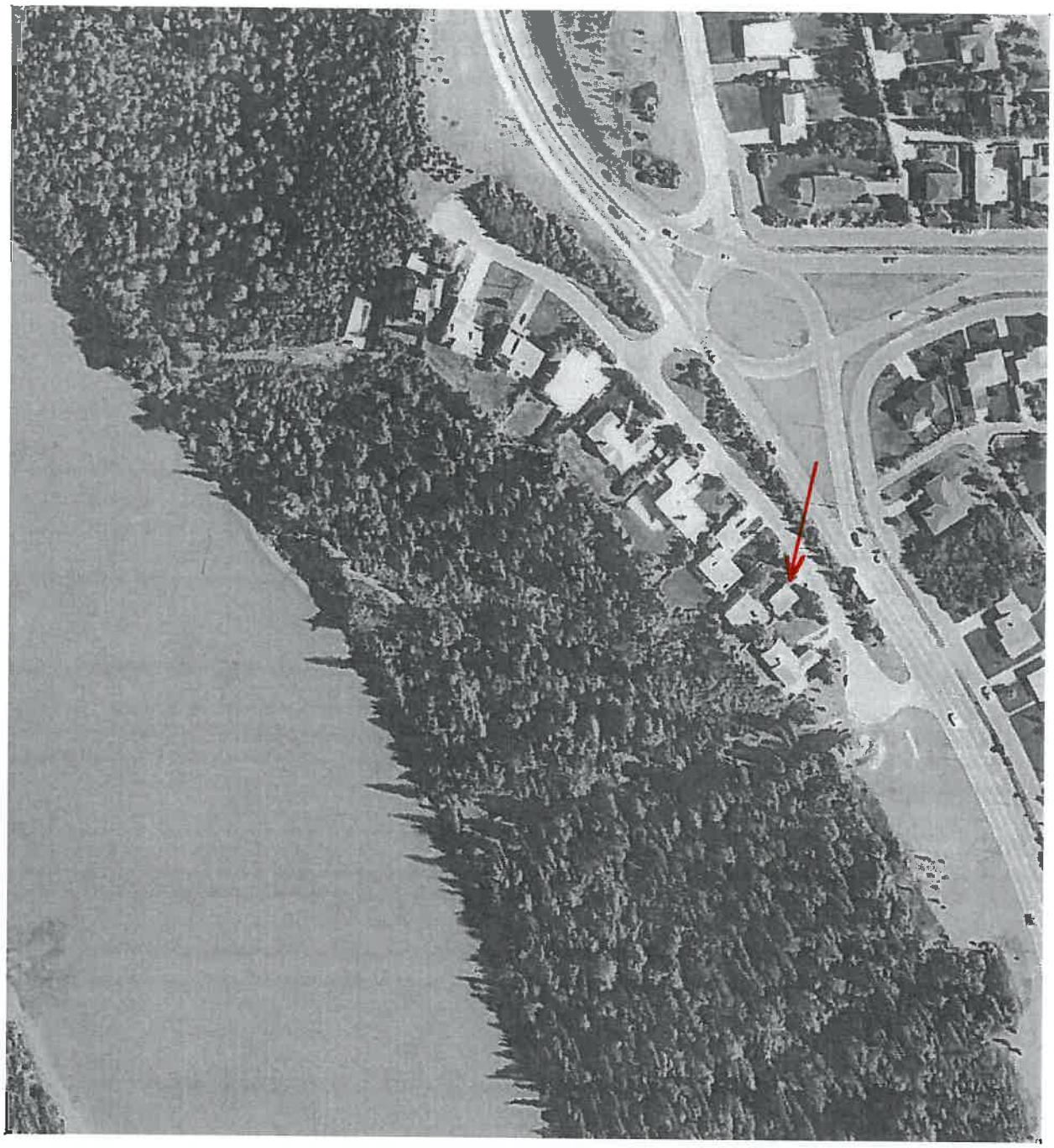
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1965		
DATE 05/29/14	DWN. MLW	CHKD. DSN	FILE NO. 02-1781-C8	DWG. NO. C-8	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1967)

APPROXIMATE SCALE 1 : 2 500

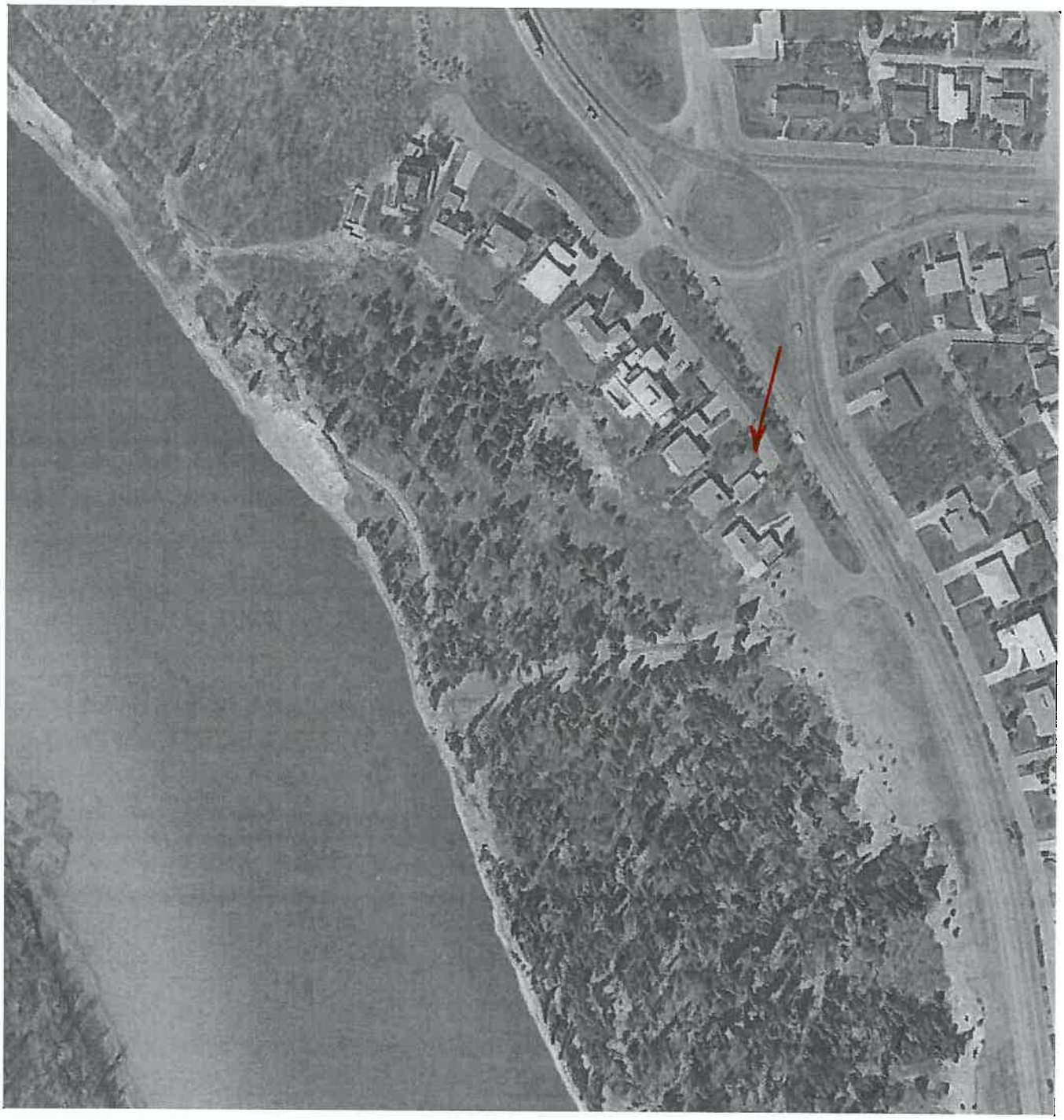
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1967		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C9	DWG. NO.: C-9	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1969)

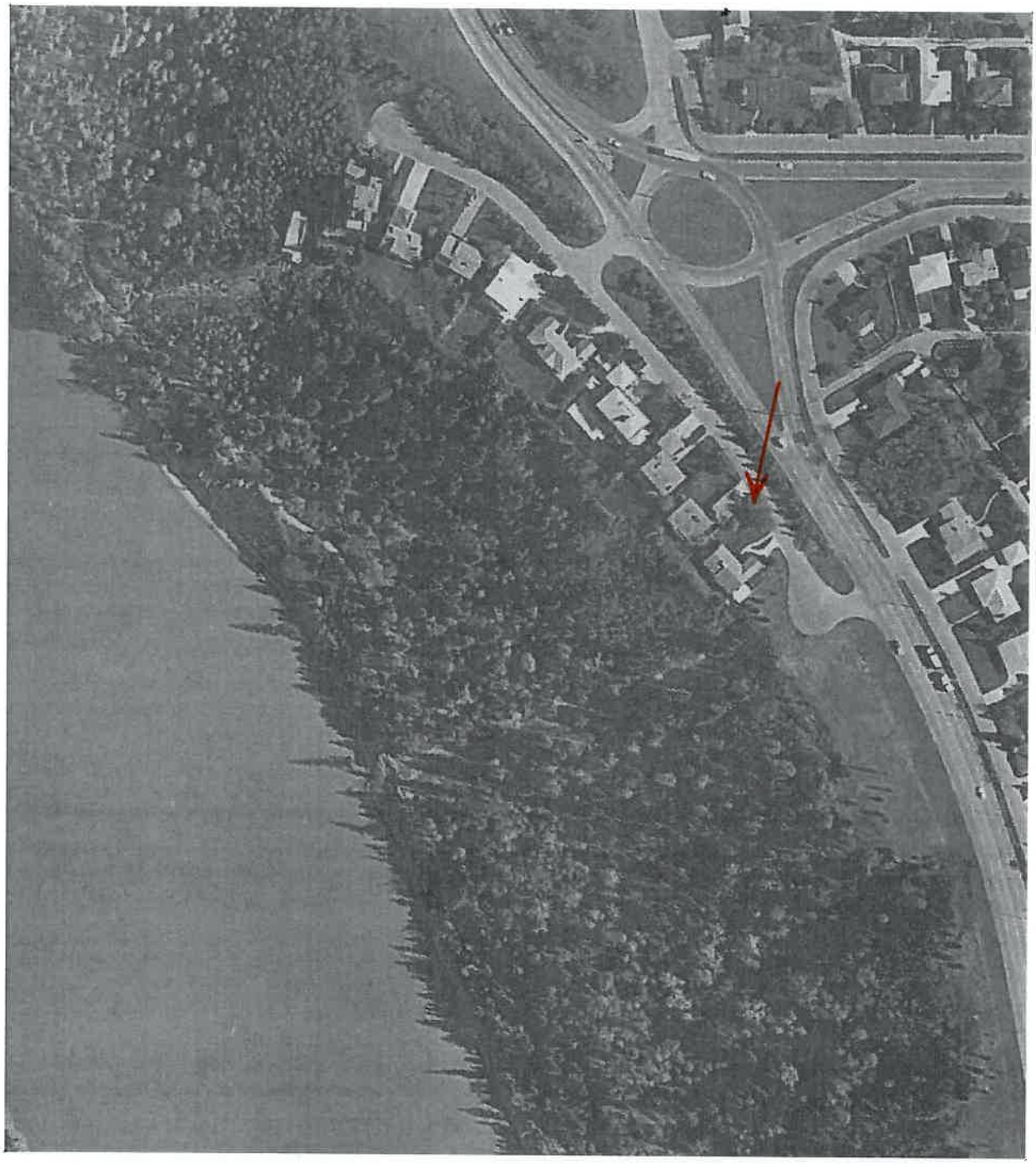
APPROXIMATE SCALE 1 : 2 500

CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1969		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C10	DWG. NO.: C-10	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1971) APPROXIMATE SCALE 1 : 2 500

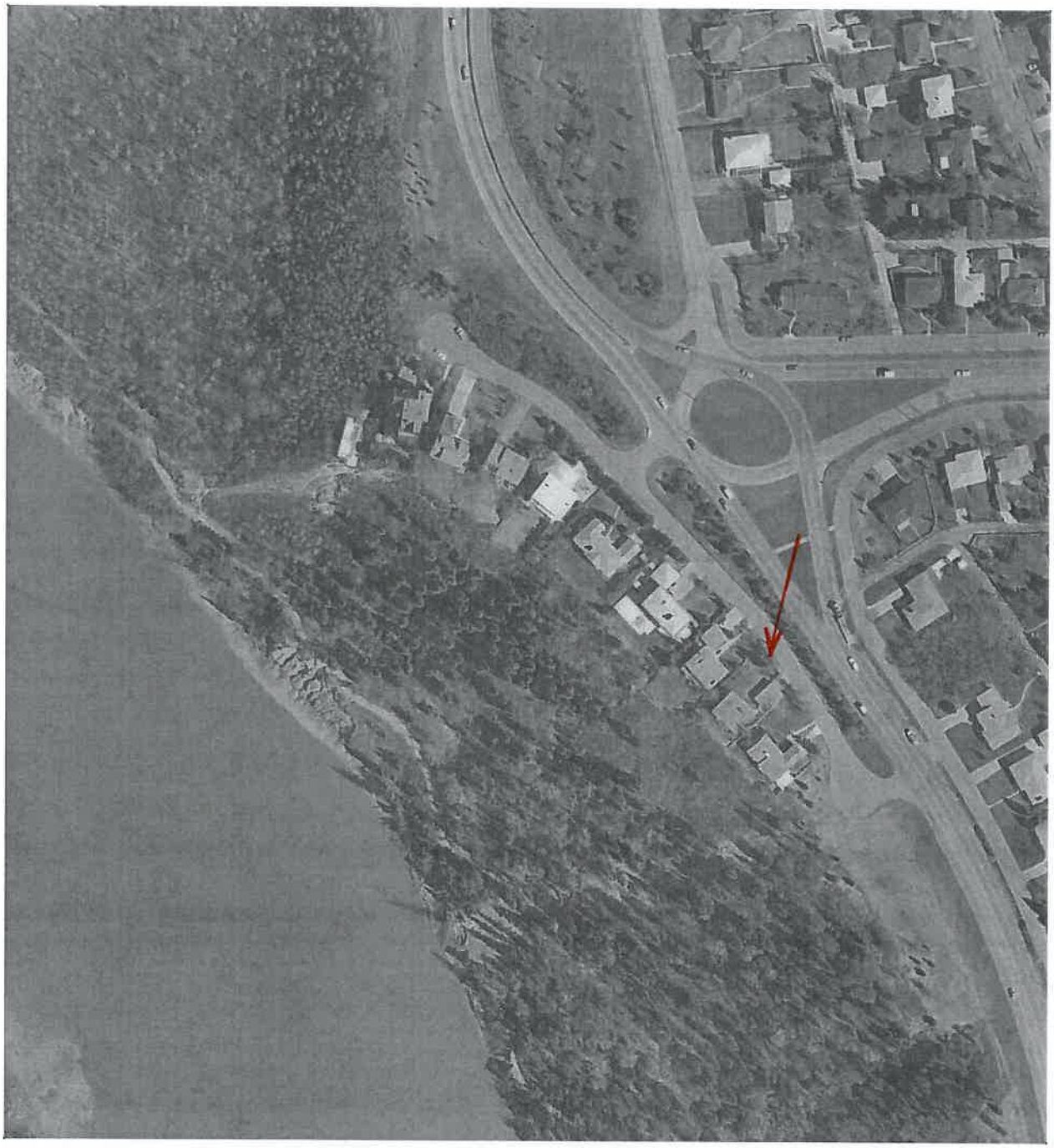
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1971		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C11	DWG. NO.: C-11	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1974)

APPROXIMATE SCALE 1 : 2 500

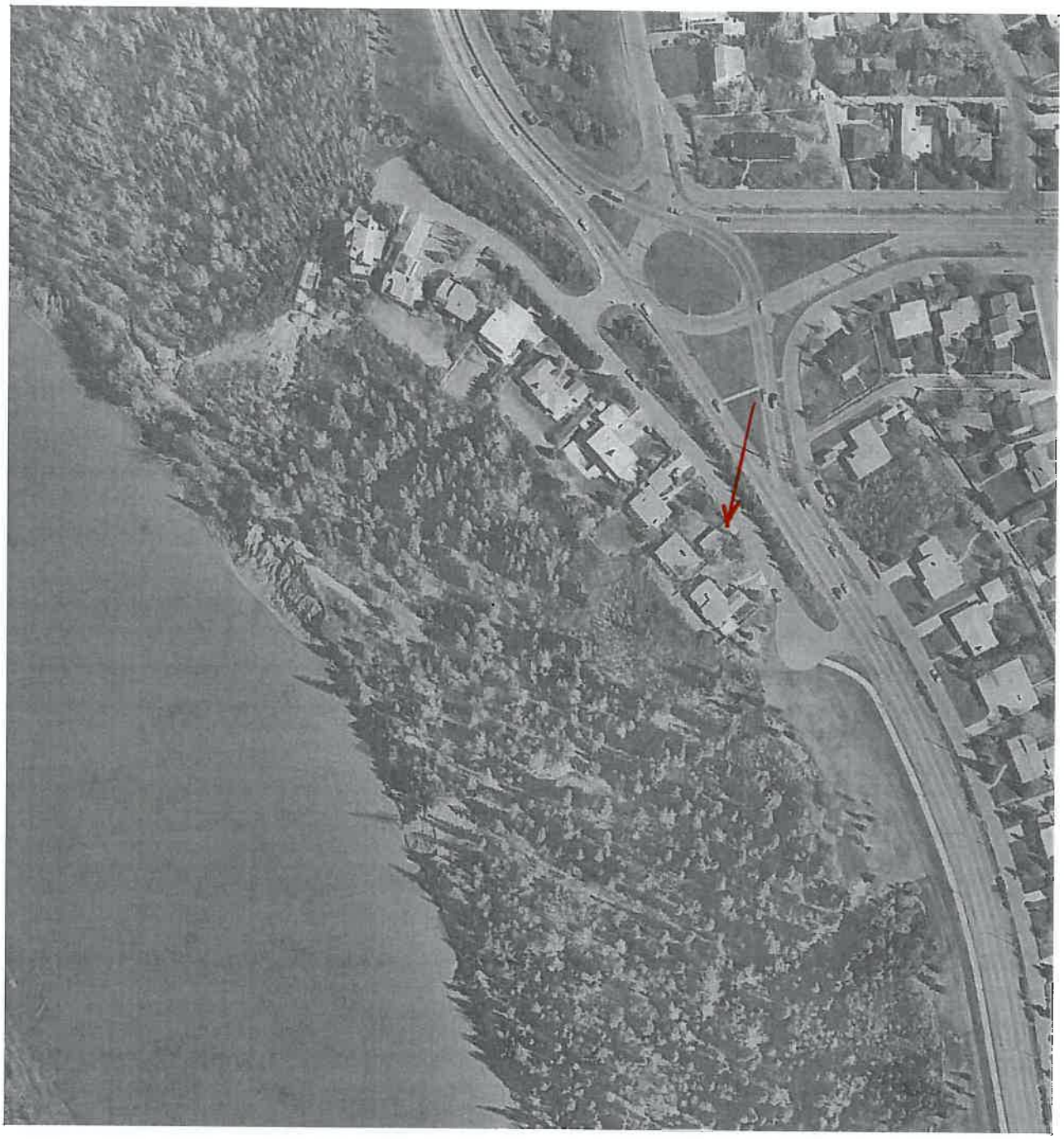
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1974		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C12	DWG. NO.: C-12	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1976)

APPROXIMATE SCALE 1 : 2 500

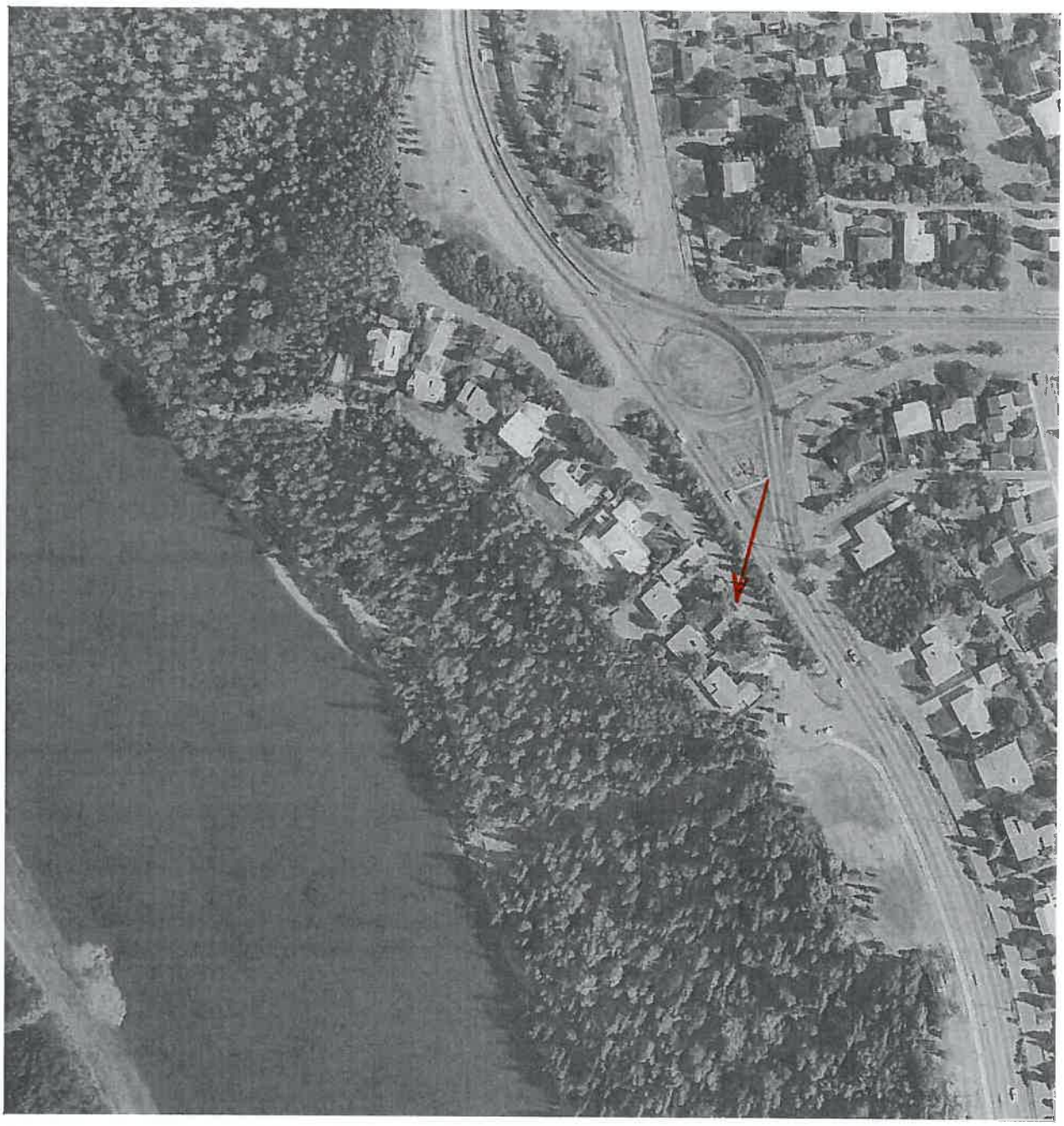
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1976		
DATE 05/29/14	DWN. MLW	CHKD. DSN	FILE NO. 02-1781-C13	DWG. NO. C-13	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1978)

APPROXIMATE SCALE 1 : 2 500

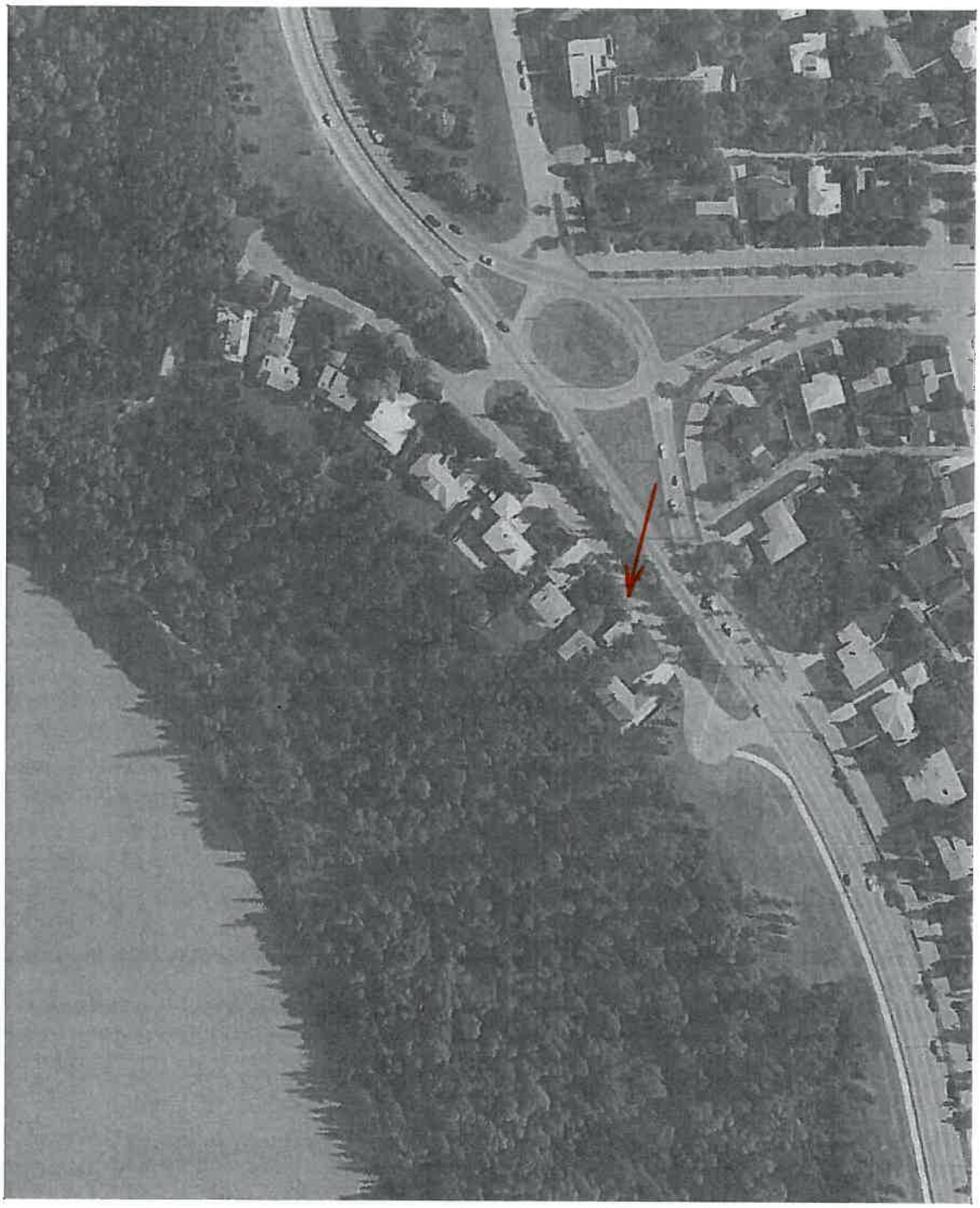
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1978		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C14	DWG. NO.: C-14	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1980)

APPROXIMATE SCALE 1 : 2 500

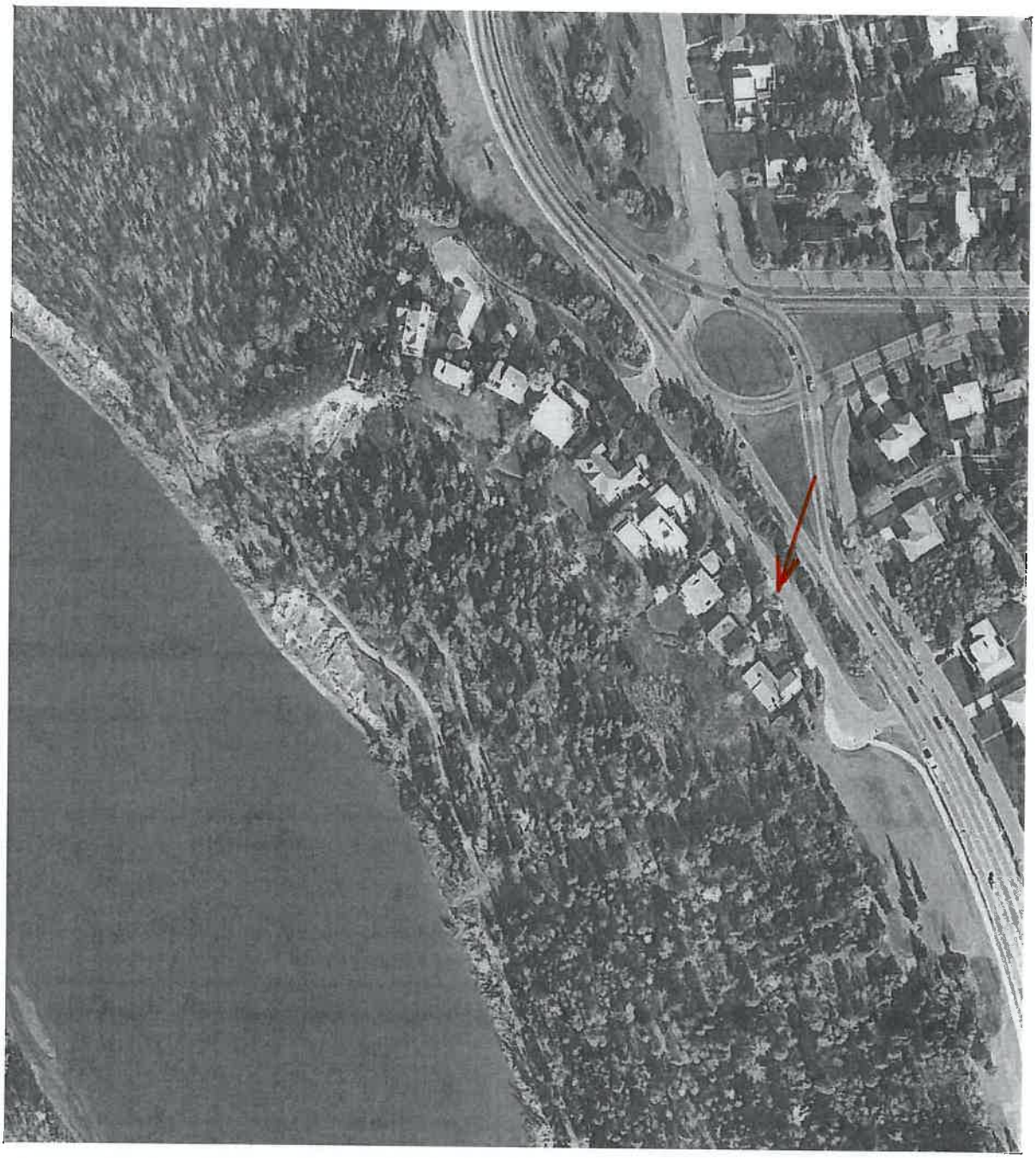
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1980		
DATE 05/29/14	DWN. MLW	CHKD. DSN	FILE NO. 02-1781-C15	DWG. NO. C-15	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1984)

APPROXIMATE SCALE 1 : 2 500

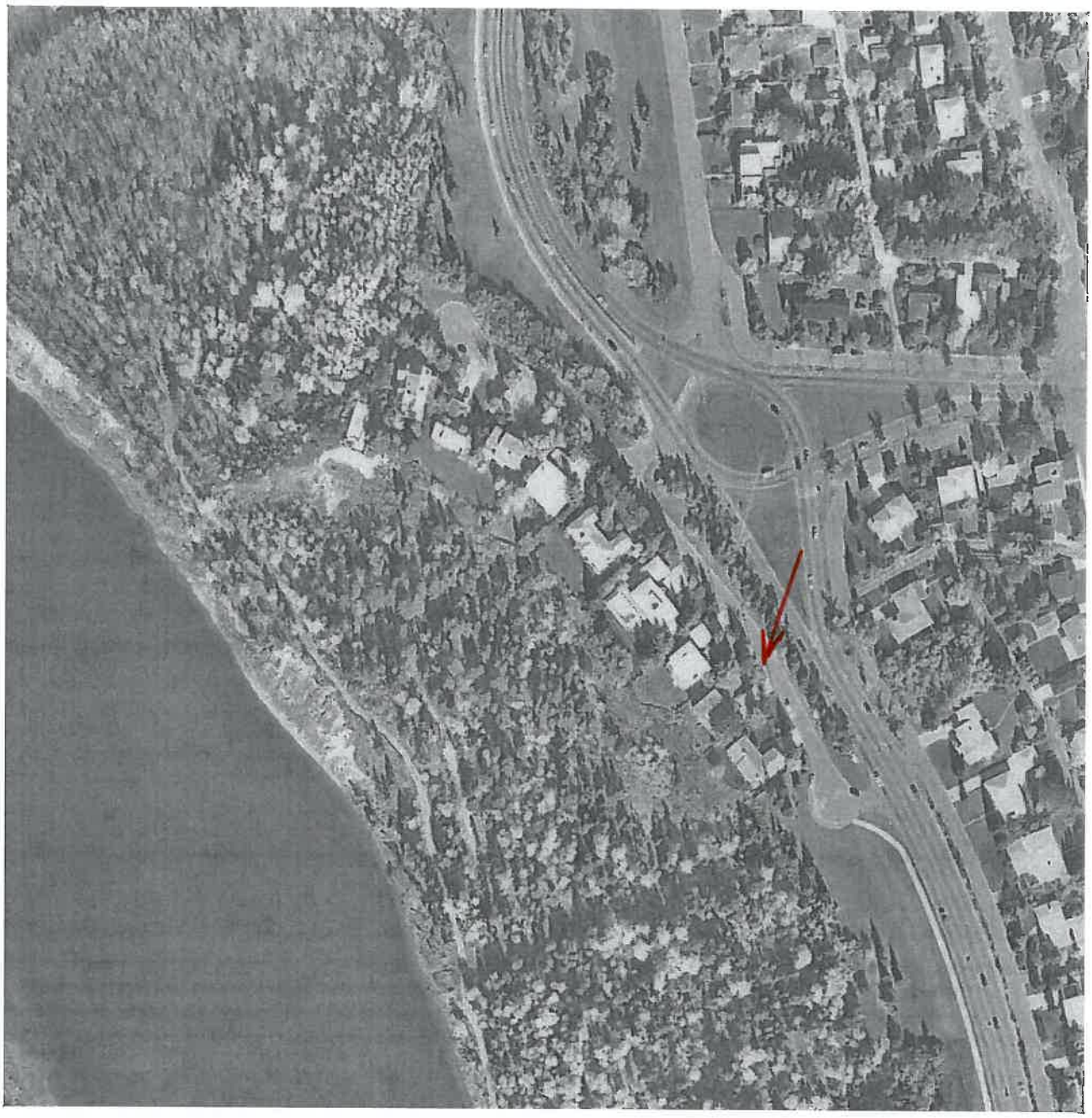
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1984		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C16	DWG. NO.: C-16	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1986)

APPROXIMATE SCALE 1 : 2 500

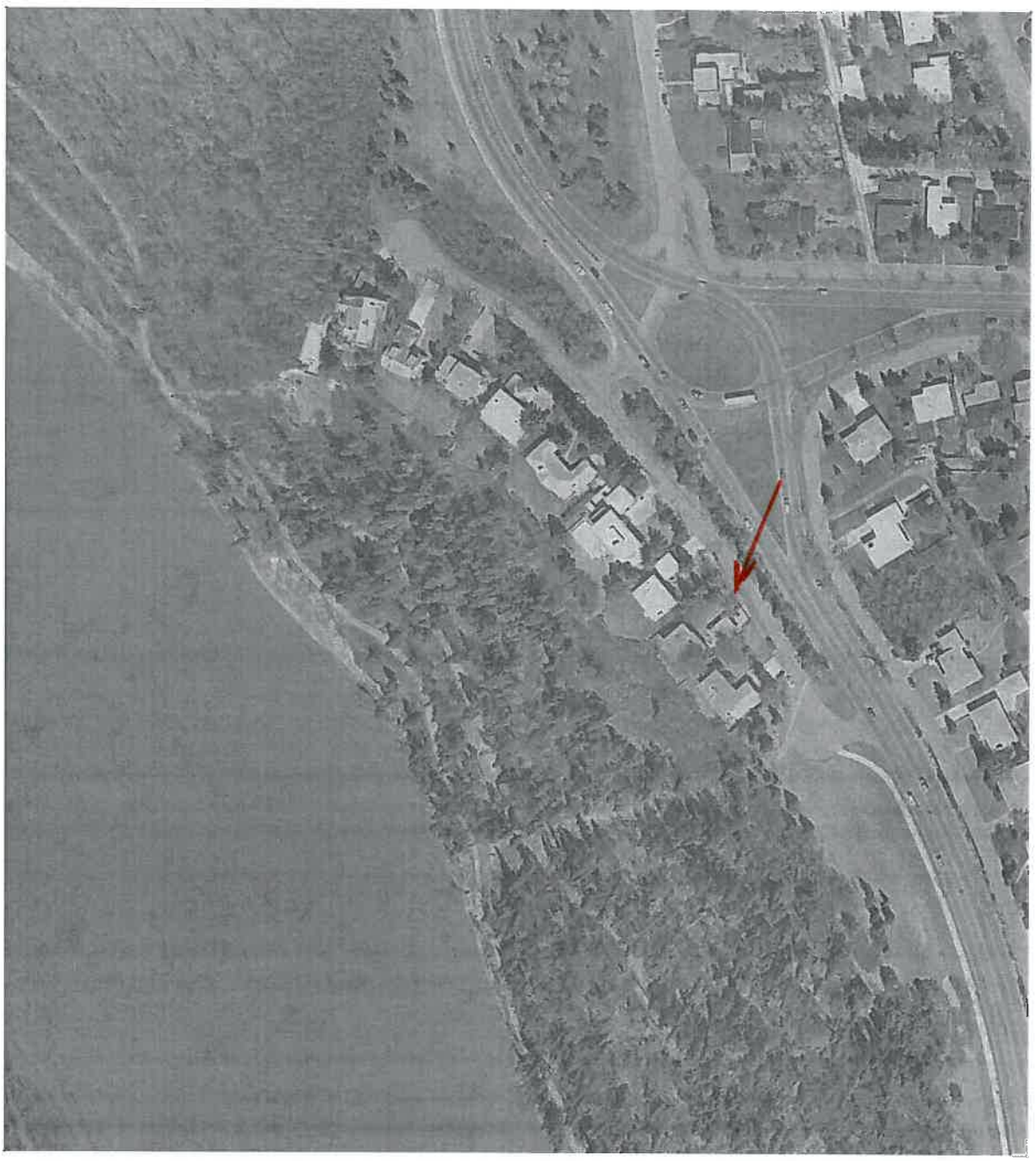
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1986		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C17	DWG. NO.: C-17	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1988)

APPROXIMATE SCALE 1 : 2 500

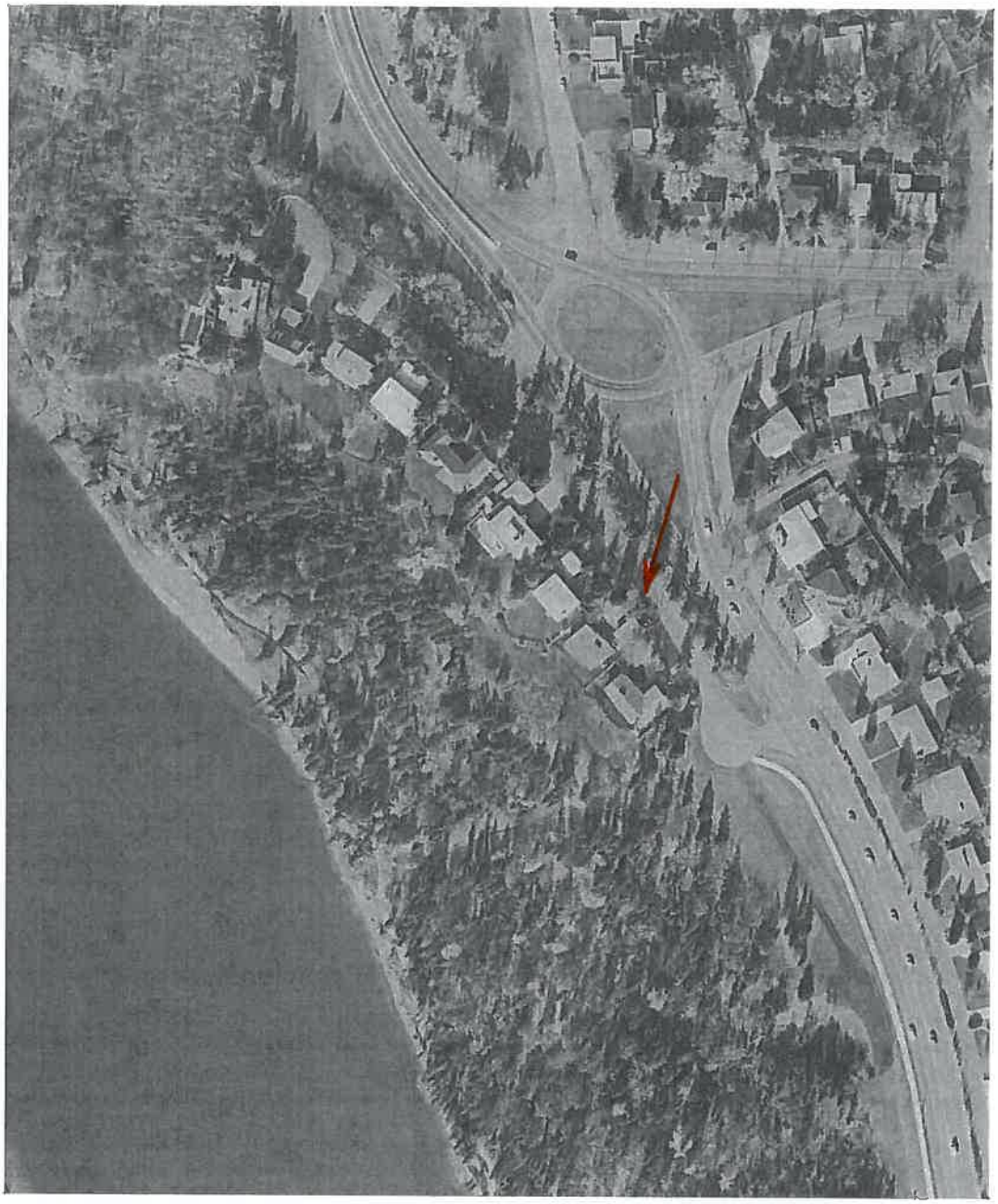
CT & ASSOCIATES ENGINEERING INC.			PROJECT	SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT	LOUIS CSABA		TITLE	SITE AIR PHOTO - 1988	
DATE 05/29/14	DWN. MLW	CHKD. DSN	FILE NO. 02-1781-C18		DWG. NO. C-18



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1990)

APPROXIMATE SCALE 1 : 2 500

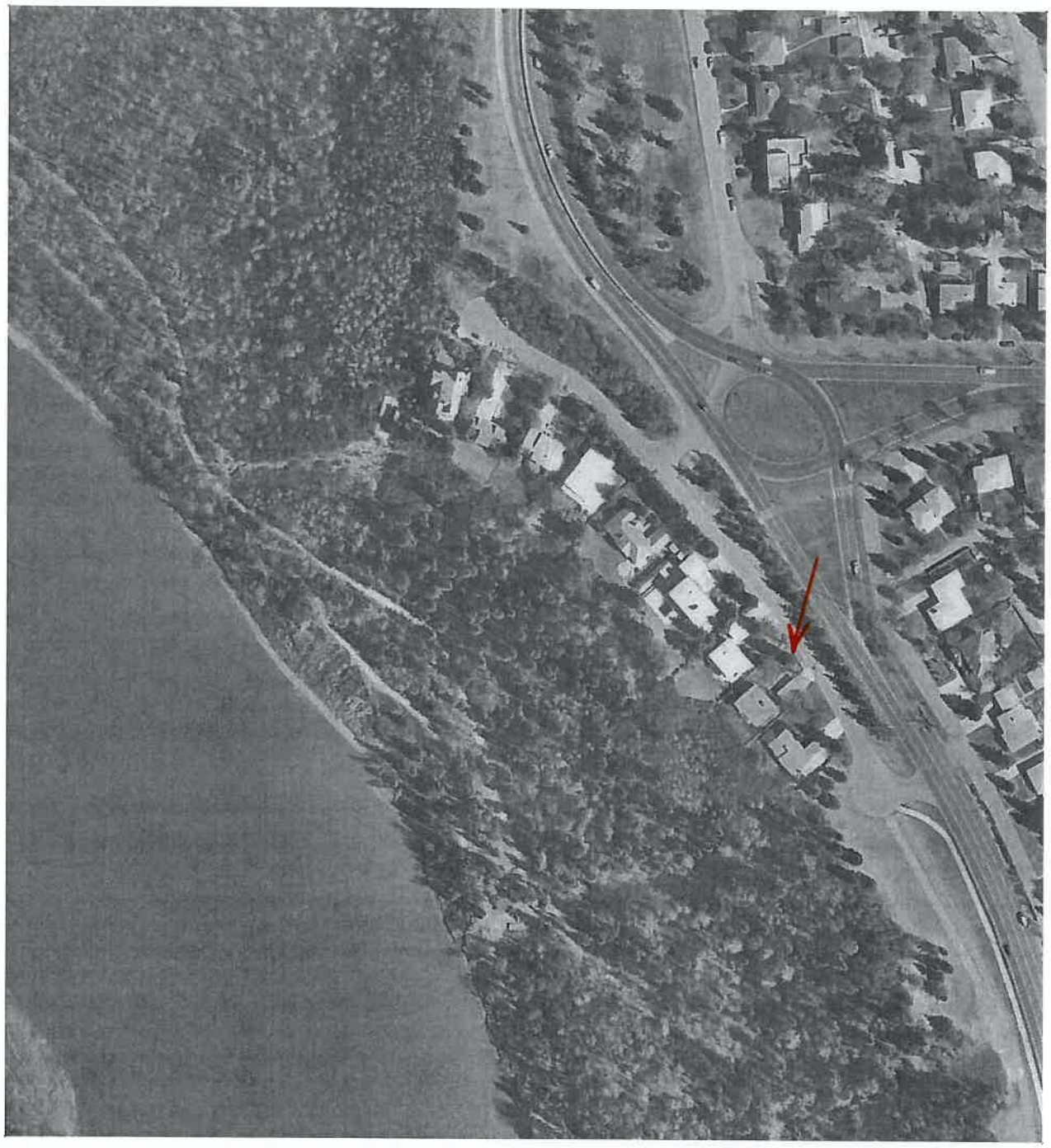
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1990		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C19	DWG. NO.: C-19	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1992)

APPROXIMATE SCALE 1 : 2 500

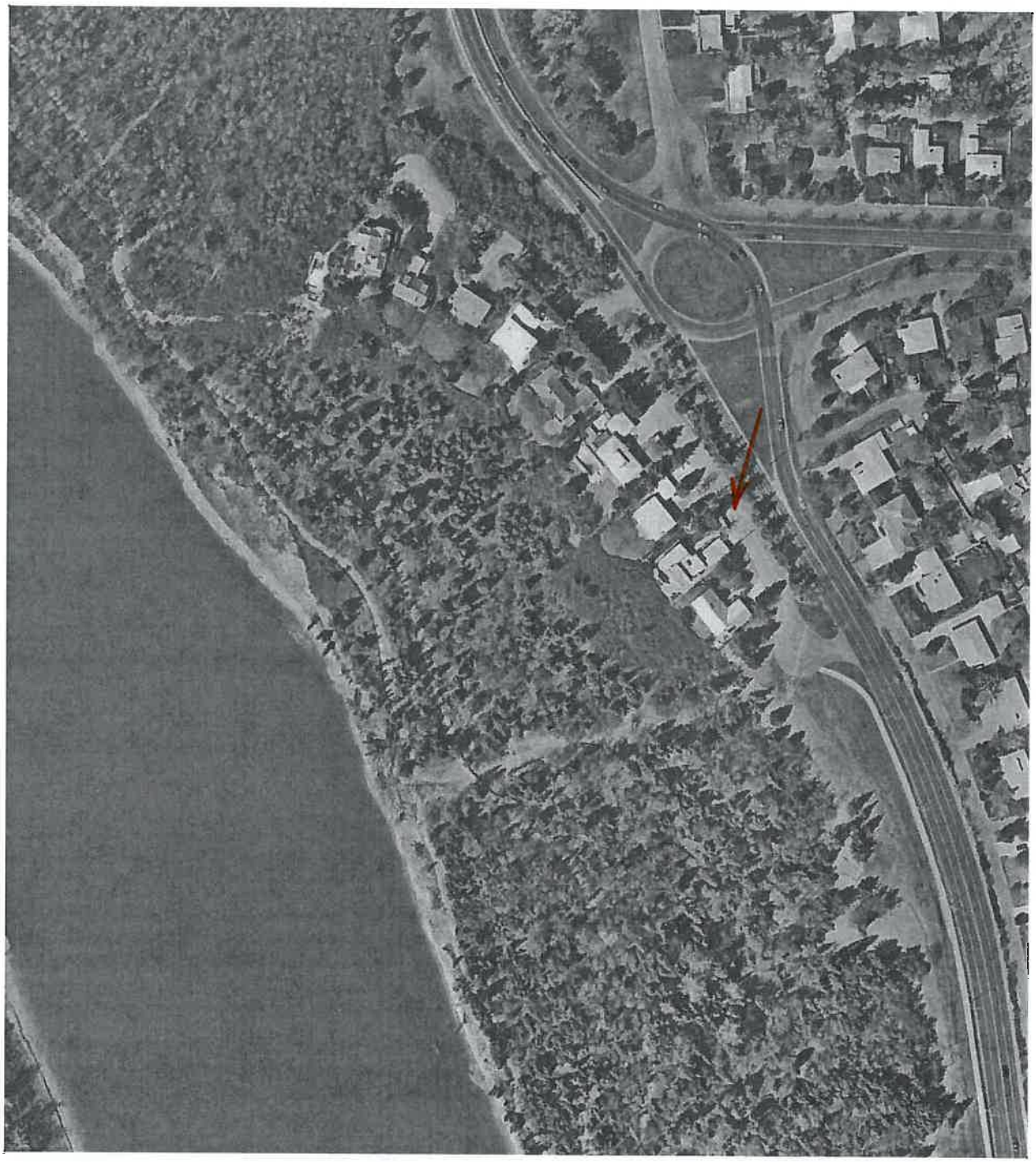
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1992		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C20	DWG. NO.: C-20	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1995)

APPROXIMATE SCALE 1 : 2 500

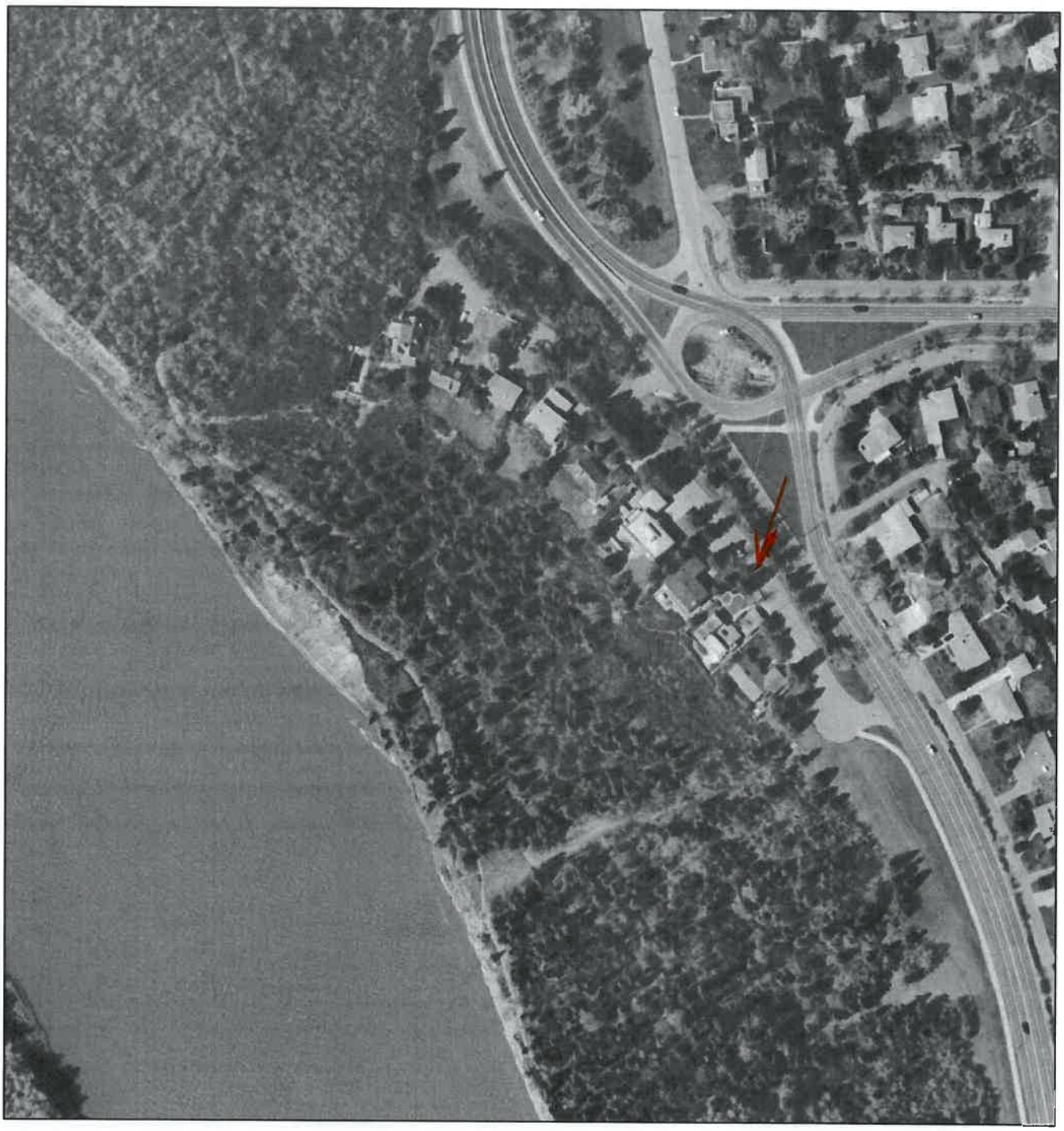
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1995		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C21	DWG. NO.: C-21	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (1997)

APPROXIMATE SCALE 1 : 2 500

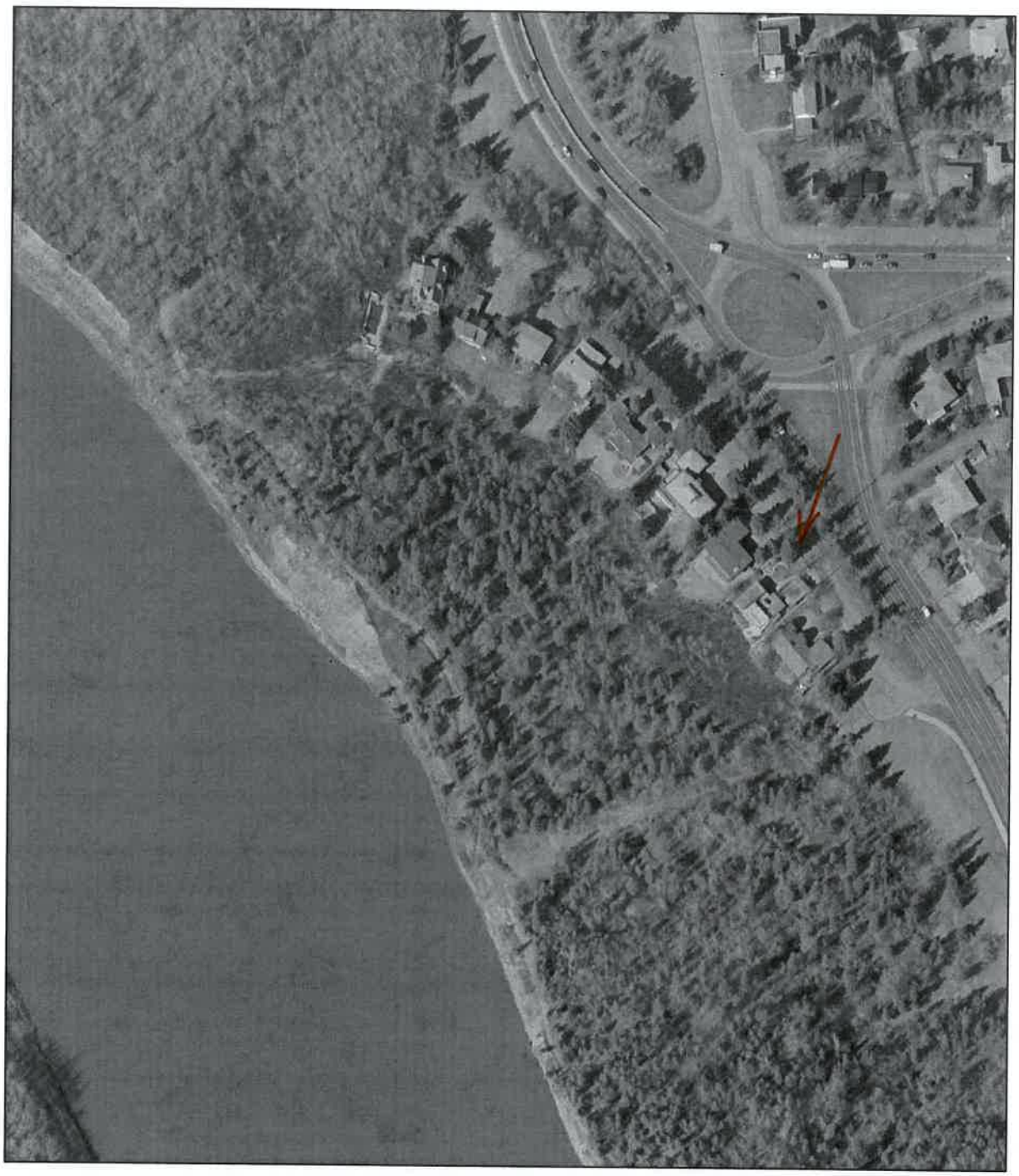
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 1997		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C22	DWG. NO.: C-22	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (2003)

APPROXIMATE SCALE 1 : 2 500

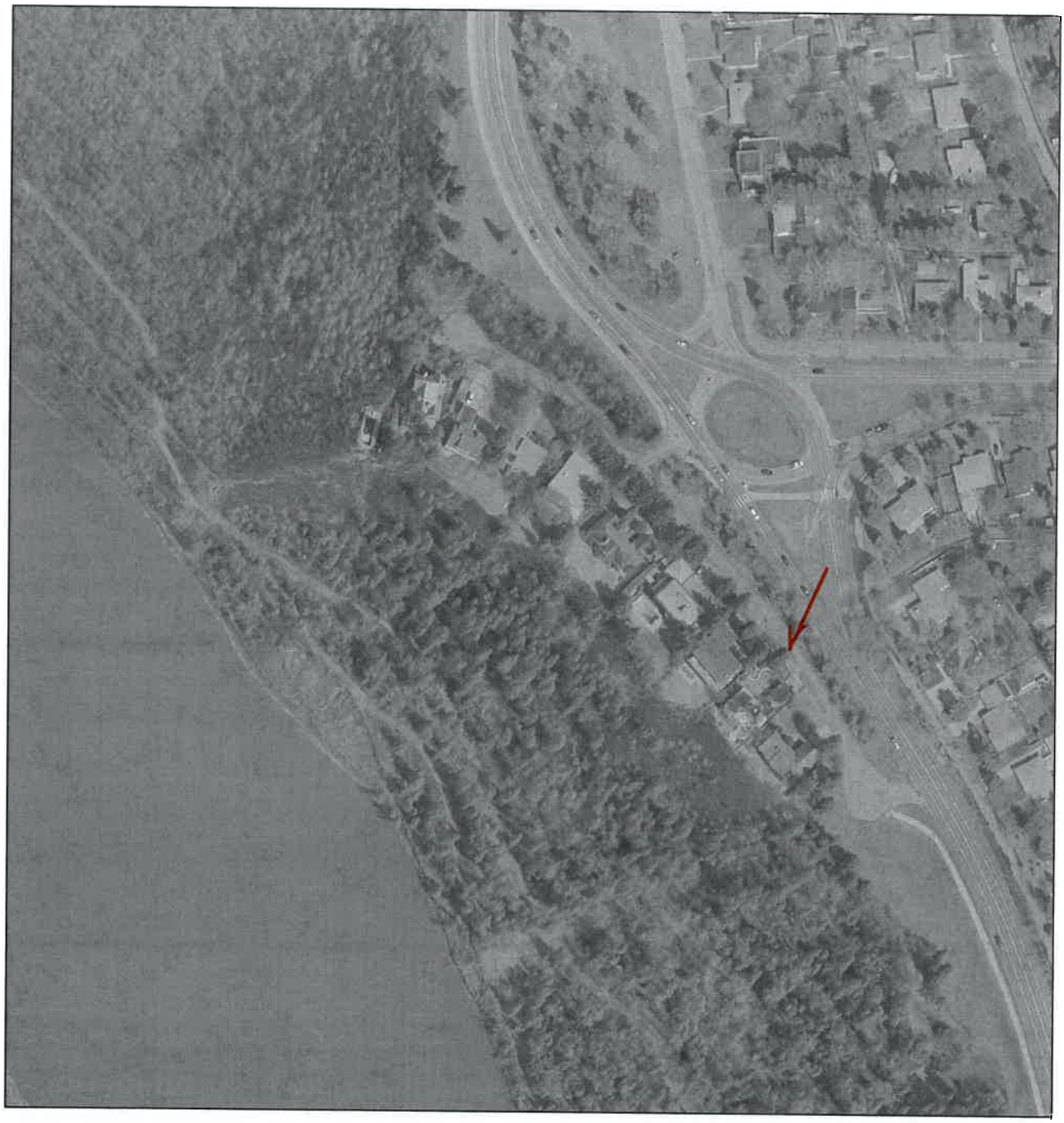
CT & ASSOCIATES ENGINEERING INC.			PROJECT	SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT	LOUIS CSABA		TITLE	SITE AIR PHOTO - 2003	
DATE 05/29/14	DWN. MLW	CHKD. DSN	FILE NO. 02-1781-C23		DWG. NO. C-23



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (2005)

APPROXIMATE SCALE 1 : 2 500

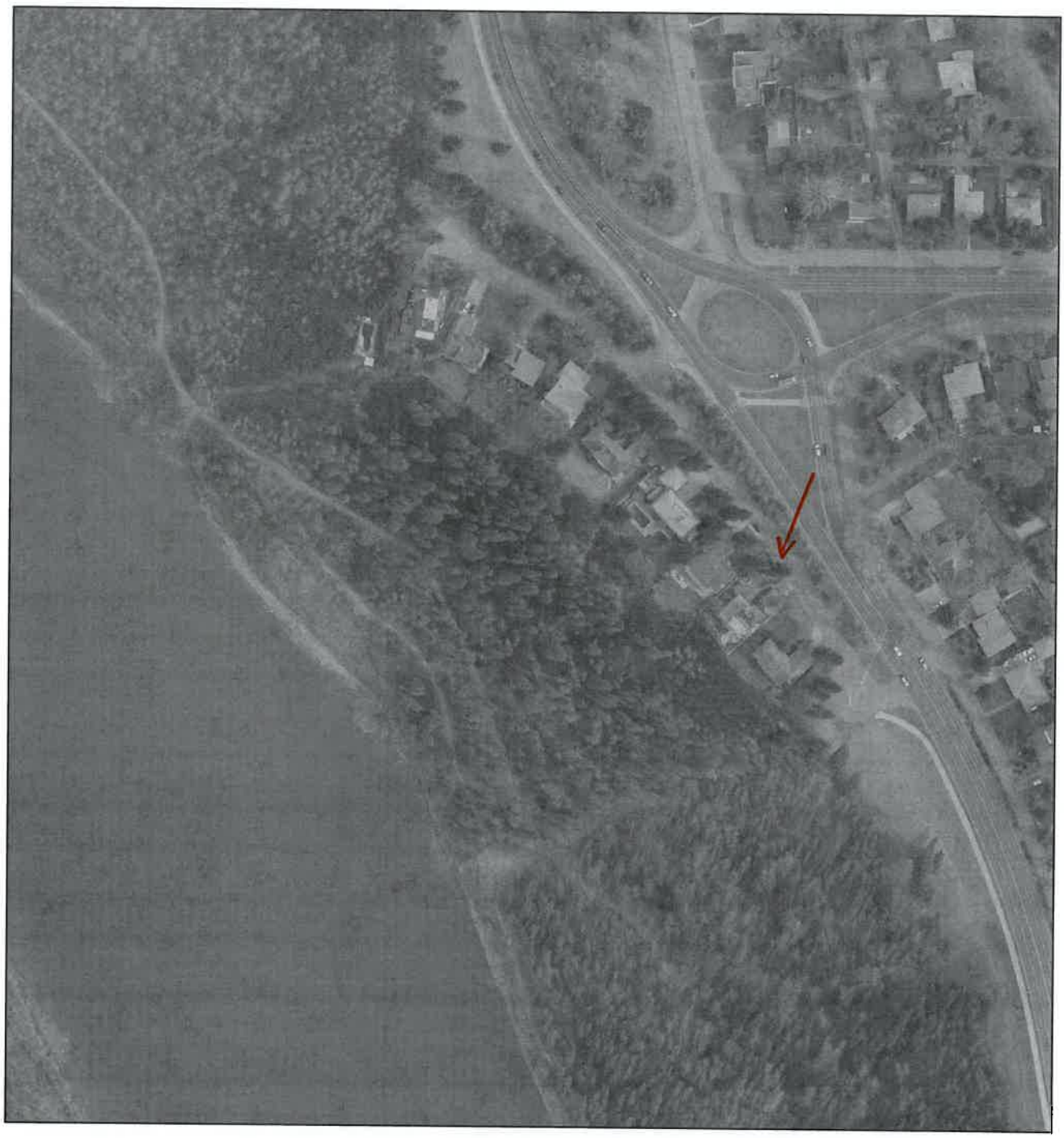
CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 2005		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C24	DWG. NO.: C-24	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (2007)

APPROXIMATE SCALE 1 : 2 500

CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 2007		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C25	DWG. NO.: C-25	



NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (2009)

APPROXIMATE SCALE 1 : 2 500

CT & ASSOCIATES ENGINEERING INC.			PROJECT: SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA		
CLIENT: LOUIS CSABA			TITLE: SITE AIR PHOTO - 2009		
DATE: 05/29/14	DWN.: MLW	CHKD.: DSN	FILE NO.: 02-1781-C26	DWG. NO.: C-26	

NOTE: BASED ON CITY OF EDMONTON ARCHIVES AIR PHOTO (2013)

APPROXIMATE SCALE 1 : 2 500

CT & ASSOCIATES ENGINEERING INC.			PROJECT	SLOPE STABILITY EVALUATION 8606 SASKATCHEWAN DRIVE EDMONTON, ALBERTA	
CLIENT	LOUIS CSABA		TITLE	SITE AIR PHOTO - 2013	
DATE 05/29/14	DWN. MLW	CHKD. DSN	FILE NO. 02-1781-C27		DWG. NO. C-27

APPENDIX E

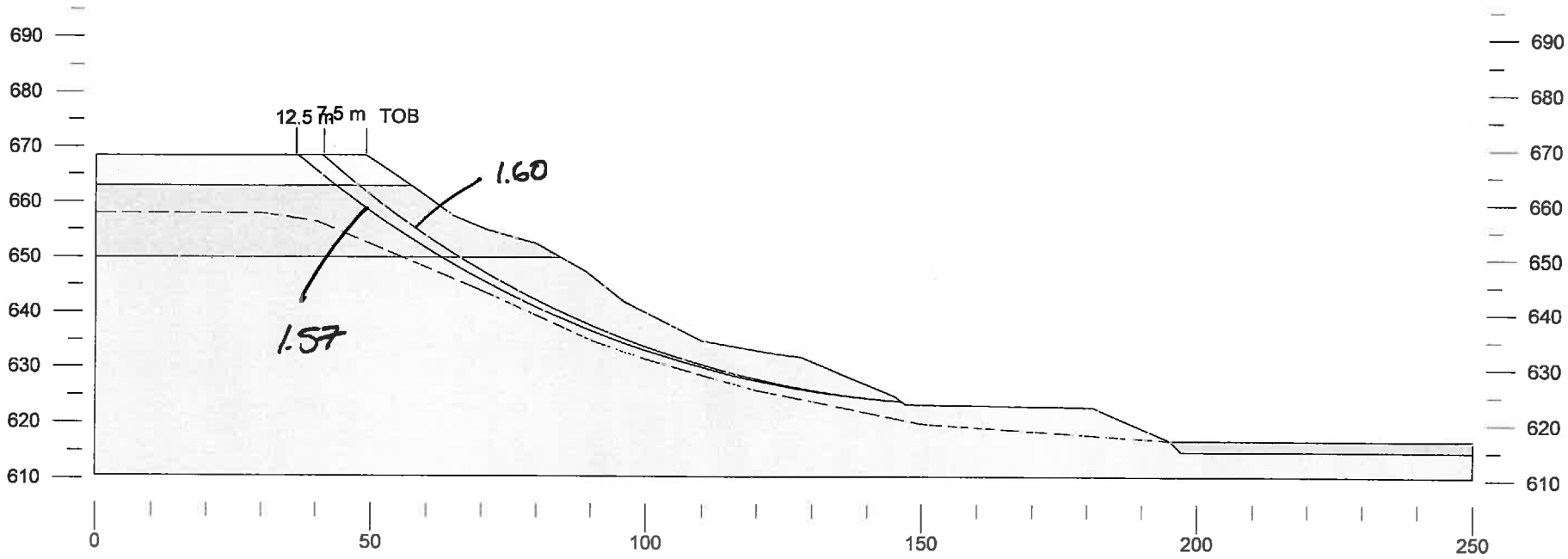
SLOPE STABILITY ANALYSIS

F = 1.601

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Water	10	0	0	0
Clay	19	0	30	1
Clay Till	19	5	30	1
Bedrock	22	25	25	1

CT & Associates Engineering - Edmonton, AB
8606 Saskatchewan Drive
Cross Section A-A

Raised GWL



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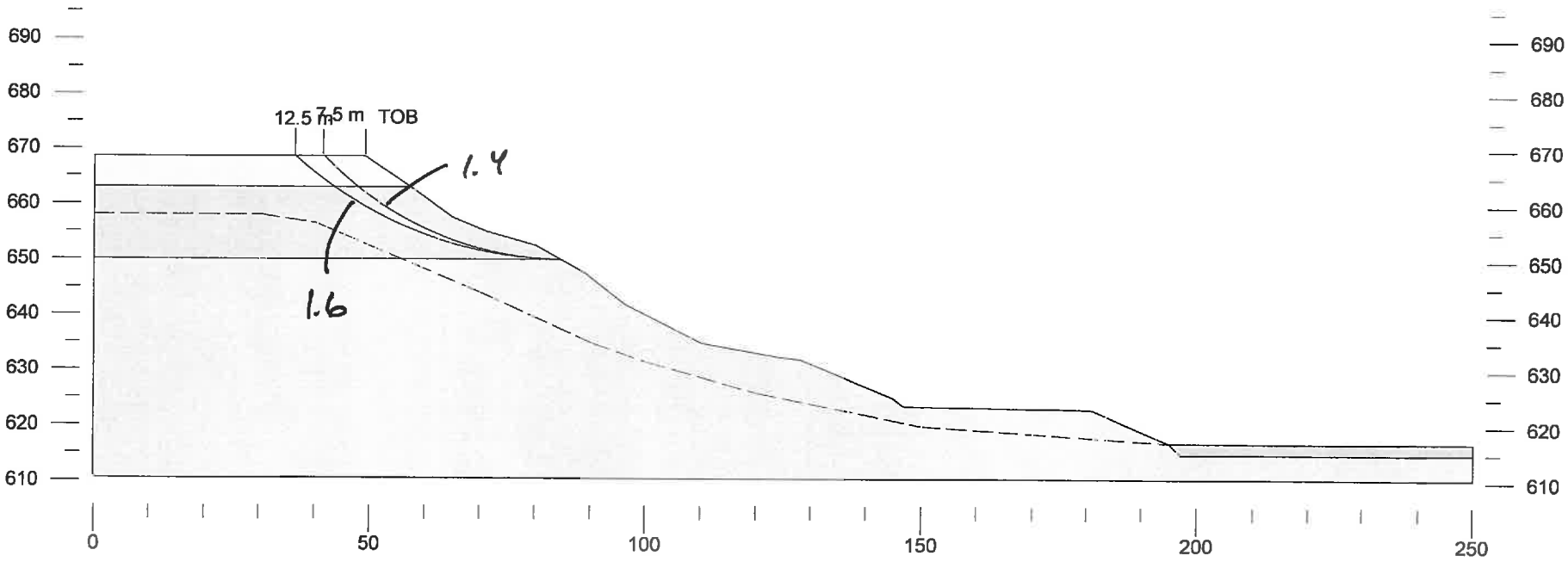
	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Water	10	0	0	0
Clay	19	0	30	1
Clay Till	19	5	30	1
Bedrock	22	25	25	1

CT & Associates Engineering - Edmonton, AB
8606 Saskatchewan Drive
Cross Section A-A

Raised GWL

F = 1.445



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	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Water	10	0	0	0
Clay	19	0	30	1
Clay Till	19	5	30	1
Bedrock	22	0	25	1

CT & Associates Engineering - Edmonton, AB
8606 Saskatchewan Drive
Cross Section A-A

Raised GWL