BYLAW NO. 7/85

A BYLAW OF THE TOWN OF LUMSDEN TO AUTHORIZE THE EXECUTION OF A CERTAIN AGREEMENT BETWEEN THE TOWN OF LUMSDEN AND RALPH DALE HARYETT AND DIANE ARLENE HARYETT

The Council of the Town of Lumsden, in the Province of Saskatchewan, enacts as follows: -

1. The Mayor and Town Administrator are hereby authorized to execute under the seal of the Town an agreement in writing between the Town of Lumsden and Ralph Dale Haryett and Diane Arlene Haryett both of the Town of Lumsden dated the 13 day of May, 1985, which agreement is marked Exhibit "A", attached hereto and forms part of this Bylaw.

Louise Holloway
Mayor

Town Administrator

CERTIFIED A TRUE COPY
of Bylaw No. 7/85 passed
by resolution of Council
on the 13 day of May, 1985.

Town Administrator

This is Exhibit "B" to the Agreement signed between the Town of Lumsden and Ralph Dale Haryett and Diane Ariene Haryett on the 13th day of May, 1985.

Ralph Dale Haryett
Diane Arlene Haryett
Louise Holloway

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
LUMSDEN, SASKATCHEWAN

Prepared For:

Mr. Ralph Haryett
P.O. Box 402
Lumsden, Saskatchewan
S0G 3C0

Prepared By:
BBT Geotechnical Consultants Ltd.
608 McLeod Street
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BBT Project No. S83-1606

FEBRUARY, 1984

BBT Geotechnical Consultants Ltd.

1.0 INTRODUCTION

1.1 Terms of Reference

The following report presents the results of a geotechnical investigation conducted at the site of a proposed residential development to be located on the south valley wall of the Qu'Appelle Valley in Lumsden, Saskatchewan (see Drawing No. S83-1606-1). The objectives of the investigation were to assess the existing stability of the valley wall against slope failure, to assess the impact of the development on slope stability, and to evaluate the suitability for the proposed development.

At the outset of the investigation, the owners provided BBT Geotechnical Consultants Ltd. with a copy of a Geotechnical Investigation Report by Ground Engineering Ltd. (GE-466) dated August 11, 1978 which pertained to the south-west portion of the proposed subdivision. Subsequent to submission of the Ground Engineering Ltd. report the subdivision was increased in size by adding the easterly portion. BBT were requested to provide a geotechnical evaluation of the additional property only as shown on Drawing No. S83-1606-1.

Proposed Development

It was understood that the overall proposed development will consist of up to 32 residential lots, several public reserve areas and associated roadways. The residential homes will likely consist of 1 or 2 storey, wood frame structures with a basement below. Roads will also be constructed as part of the overall development to provide access to the residences. An outline of proposed subdivision and roadways are shown on Drawing No. S83-1606-2.

2.0 EXTENT OF INVESTIGATION

2.1 Field Investigation

The test drilling program consisted of 2 test holes located as shown on Drawing No. S83-1606-2. The test holes were 7 inches in diameter and were drilled to a depth of 100 feet below existing grade using a CME Model 75 hollow stem auger rig. The test hole elevations were estimated using G.S.C. Bench Mark No. 7D which had a reported elevation of 1630.66 feet feet above sea level. The bench mark was located approximately 1 foot south of the northeast corner of the existing post office in Lumsden, Saskatchewan.

A test hole drill log was compiled for each test hole as drilling progressed to record a description and the relative position of the various soils encountered. Standard penetration tests were conducted at 5 foot intervals from a depth of 10 to 55 feet at Test Hole No. 2. Additional disturbed bag samples were recovered at the 1, 3 and 5 foot depths from both test holes. Undisturbed shelby tube samples were recovered at 5 foot intervals from a depth of 60 to 70 feet (Test Hole No. 2) and 10 to 55 feet (Test Hole No. 1) below existing grade. A continuous core sample was obtained below a depth of 60 feet (Test Hole No. 1) and 70 feet (Test Hole No. 2) which extended to the bottom of each test hole. All soil samples were sealed and transported to our laboratory for examination, testing and analysis.

A 2 inch diameter plastic standpipe piezometer was installed to depths of 57.5 feet (Test Hole No. 1) and 100 feet (Test Hole No. 2) below existing grade to monitor future static groundwater levels at those locations.

2.2 Laboratory Testing

A visual classification was performed on all soil samples after they were received in the laboratory to confirm or adjust the field identification.

Moisture content tests were performed on all soil samples to assess the regularity of soil characteristics with depth and across the site in addition to serving as a complement to other laboratory testing. Atterberg limits, dry density and grain size distribution tests were conducted on selected samples to aid in the classification and to assess some of the physical properties of the soil.

The undrained shear strength of the soil was assessed by means of unconfined compressive strength tests which were supplemented by Soiltest pocket penetrometer readings.

2.3 Aerial Photographs, Topograph Map and Review of Existing Information

Aerial photographs and a topographic map of the area were examined in order to evaluate the terrain and relief of the subdivision. In addition, the topographic map was used to establish the ground surface elevations in the cross sections shown at the end of this report.

A geotechnical report produced by Ground Engineering Ltd. (GE-466) and dated August 11, 1978 was reviewed to assist in this evaluation. The report contained information relating to an adjacent area (Parcel A, Plan No. 75R43504) located to the west and southwest of this subdivision under consideration. Certain soil strength parameters used in the evaluation were drawn from this report.

3.0 SITE DESCRIPTION

The proposed subdivision lies approximately half way up the south valley wall of the Qu'Appelle Valley in Lumsden, Saskatchewan.

The valley wall at this site is sloping at a present angle of approximately 7.5 degrees near the crest of the slope, nearly level at the mid-point of slope and 10 to 14 degrees to the horizontal at the toe of the slope. The proposed subdivision lies in an area of old slump blocks which have slid down the valley wall and which are presently at or above equilibrium.

Surficial features such as moderate headscarps, hummocky broken slopes and a pattern of subparallel ridges down slope are indications of past instability of this area.

The general drainage is provided by means of surface runoff into ravines which, in turn, are directed downward towards the valley. The ravines contained shrubs and trees which are indigeneous to a moist soil regime. The vegetated areas above the ravines indicated a somewhat dryer soil at surface and were sparsely covered by grass and small trees.

Photographs taken of the site at the time of drilling are enclosed in Appendix B at the end of this report.

4.0 SUBSURFACE SOIL CONDITIONS

4.1 Surficial Geology of the Area

The regional geology of this area has been reported by Christiansen, (et al) with particular emphasis on the bedrock topography. The bedrock has been reported to be a marine clay shale of the Bearpaw Formation.

Undifferentiated glacial till and intertill stratified drift lie above the bedrock and, in areas outside the valley, are generally overlain with glacial lacustrine clays.

The Qu'Appelle Valley is a remanent of a glacial meltwater channel which has agraded through deposition of more than 200 feet of alluvial sediment. The slopes along the valley have occured as a result of erosion from the meltwater runoff, the depth of which has extended below the drift-bedrock contact. The widening of the Qu'Appelle Valley has occured as a result of the successive landslides which has attained a profile in equilibrium with its environment.

4.2 Soil Profile

The soil profiles for the 2 test holes drilled under this study are plotted and illustrated on Drawing Nos. S83-1606-3 and S83-1606-4 respectively.

Glacial drift consisting of weathered brown till, sand and unoxidized grey till was encountered at each test hole location and extended to 38 to 55 feet below existing grade. Clay shale of the Bearpaw Formation was encountered below the drift at an elevation of 1683 to 1686 feet above sea level and extended to the bottom of each test hole. The composition of the shale varied somewhat between test hole locations and with depth.

4.3 Soil Properties

The results of soil classifications and laboratory tests are plotted beside the corresponding drill logs on Drawing Nos. S83-1606-3 and S83-1606-4 respectively. Grain size distribution curves are plotted on Drawing Nos. S83-1606-5 to S83-1606-9 inclusive.

The weathered glacial till at the surface appeared severely desiccated to a depth of about 10 feet. Both tills were classified as medium plastic and generally hard except from depths of 15 feet to 20 feet and at 30 feet (Test Hole No. 1) where the till was classified as very stiff. The sand encountered within the drift was classified as dense on the basis of standard penetration blow counts that ranged from a low of 31 to well in excess of 50 blows per foot.

The shale encountered below the glacial drift had noticeable fractures with slickensides throughout at Test Hole No. 2 and at random depths within Test Hole No. 1. The shale was generally classified as hard except at Test Hole No. 2 where it was assessed to be very stiff to a depth of 41.5 feet. The composition and plasticity of the shale varied between test hole locations and also with depth. At Test Hole No. 1, the shale was very sandy and low plastic (from 68 to 95 feet), whereas, at Test Hole No. 2, a lower sand content and somewhat higher plasticity was apparent.

For purposes of this study, the effective soil strength parameters established by Ground Engineering Ltd. at the nearby St. Michaels Retreat were assumed to be representative and are presented in Table I.

TABLE I

ASSUMED SOIL STRENGTH PARAMETERS

Soil Description	c'(psf)	Ø'(degrees)
Glacial Drift	50	28
Bedrock	50	8

5.0 GROUNDWATER CONDITIONS

Moderate seepage and sloughing was encountered within the silty and gravelly sand (depth 43 to 49 feet) at Test Hole No. 1. Only a trace of sloughing (without seepage) could be detected within the silty and clayey sand at Test Hole No. 2. No measurable groundwater level could be detected at Test Hole No. 2 at 32 days after drilling. The water level at Test Hole No. 1 was measured to be 33 feet and 32 feet below existing grade at one half hour and 32 days after drilling, respectively.

Groundwater conditions are expected to vary due to seasonal fluctuations.

6.0 DESIGN CONSIDERATIONS AND RECOMMENDATIONS

6.1 Slope Stability

A slope stability analysis was performed using the "SLOPE-II" computer program which was accessed through the Saskatchewan Computer Utility Corporation.

A cross section of the entire south valley wall (horizontal/vertical = 10:1) is shown on Drawing No. S83-1606-10. A segment of this section (Cross Section A-A) was used in the analysis and is shown on Drawing No. S83-1606-11 (horizontal/vertical = 1:1). The surface profiles of the cross sections were determined using a topographic map of the area made available by the Department of Rural Development, Saskatchewan. Bedrock surface and groundwater elevations were obtained from the test hole drill logs and piezometer readings. The soil strength parameters

used were in accordance with the values presented in Table I. A failure surface along the surface of the bedrock was assumed for the analysis. The analysis consisted of 2 computer runs of which the first run used the groundwater level as measured under this study and the second run used a hypothetical groundwater level which was 10 feet higher than the measured value. The groundwater table was assumed to be roughly parallel to the existing surface, exiting at the toe of the slope at the bedrock-drift interface. The higher groundwater table is thought to be a reasonable allowance for seasonal variations.

The results of the computer analysis indicated a factor of safety against slope failure of 2.64 and 1.73 for the first and second runs, respectively. These values reflect the high sensitivity of the slope stability to the groundwater level. The factors of safety are considered to be within acceptable limits for development of the subdivision. The following general guidelines are recommended for the development with respect to slope stability:

1) the final development plans should be reviewed and evaluated by a competent geotechnical consultant.
2) proper surface and subsurface drainage must be maintained
3) minimize or eliminate potential sources of water collection or infiltration (ponds, swimming pools, etc.)
4) provide protection of the slope against erosion
5) cuts and fills should be limited to prevent destabilization of old slump blocks

6) careful construction control and inspection should be performed by qualified personnel

7) the development must satisfy the requirements listed in The Planning and Development Act, 1973

Under these guidelines, it is anticipated that the proposed development will not significantly alter the long term stability of the slope. However, a monitoring program should be undertaken following development of the subdivision. This should consist of visual examinations of the slope by a competent geotechnical consultant, the installation of a slope indicator and continued monitoring of the slope indicator and the existing piezometers.

6.2 Cuts and Fills

It was understood that the site grading will primarily consist of localized lot levelling and roadway preparation and, as such, some cutting and filling will be necessary. Although the details of the cuts and fills were not available during the preparation of this report, it should be recognized that extensive changes to the slope geometry by means of cuts and fills are not recommended. However, selective cuts and fills may be used on a restricted basis and should be evaluated by the geotechnical consultant. Fills should be placed and compacted in accordance with recognized standards and procedures. Under no circumstances should residential buildings be supported on fills.

6.3 Drainge

As a result of the proposed development, some changes in drainage patterns are inevitable and, subsequently, should be evaluated. It is imperative that existing drainage paths be maintained. In particular, drainage which is presently occuring as seepage into the ravines must be maintained. Therefore, before any fills are placed in the ravines, the vegetation must first be removed followed by placement of a gravel filter blanket over the ravine bottom. The filter should be a minimum of 1 foot thick and have less than 5% of its particles passing a No. 200 sieve. The filter must be designed to provide free drainage on a year round basis.

6.4 Restoration

All exposed fills or cuts should be protected from erosion by means of vegetation or other methods as deemed necessary and should be undertaken as soon as is possible. Areas beyond the earthwork boundaries may require additional protection as well. Some long term maintenance may be necessary.

6.5 Foundations

Although the terms of reference for this report did not include an in-depth study of the possible alternates for foundation construction, the soils encountered at this site are considered suitable for foundation support of typical residential homes. Foundations supported on or by naturally deposited soils at this site would be expected to perform relatively well provided that proper design and construction methods are used.

7.0 CLOSURE

The findings and recommendations of this report were prepared in conjunction with generally accepted professional engineering principles and practice. The findings and recommendations are based on the results of field and laboratory investigations, combined with an interpolation of the soil and groundwater conditions between test hole locations. If conditions are encountered during construction that appear to be different from those shown by the test holes drilled at this site or if changes to the proposed development are undertaken, this office should be notified in order that the recommendations can be reviewed.

Respectfully submitted,

BBT GEOTECHNICAL CONSULTANTS LTD.

PROFESSIONAL ENGINEER
E. D. FROC
REGINA
SASKATCHEWAN

E.D.(Gene) Froc, P. Eng.

EDF:mt

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF SASKATCHEWAN CERTIFICATE OF AUTHORIZATION NO. 185 BBT GEOTECHNICAL CONSULTANTS LTD.

BBT Geotechnical Consultants Ltd.
BBT GEOTECHNICAL CONSULTANTS LTD.

608 McLeod Street
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Telephone (306) [redacted]
949-2104

November 13, 1984

Received From Ralph Harqett Nov. 13/84

Mr. Ralph Haryett
P.O. Box 492
Lumsden, Saskatchewan
S0G 3C0

Dear Sir:

Subject: Proposed Subdivision
NW 1/4 SEC. 28-19-21-W2M
Lumsden, Saskatchewan
BBT Project No. S83-1606

Further to your request, we have reviewed the revised plan for the lot layouts for Blocks 1 to 5 and for the proposed additional area (Lot Nos. 1 to 7) in Block 6. In addition, the undersigned, in your presence on November 2, 1984, performed a site reconnaisance and held discussions to confirm the intent of your plans for development in Block 6. It should be understood that our evaluations must be considered preliminary only and that a final evaluation will be required after the grading plans have been completed.

The potential building areas are indicated on Drawing No. S83-1606-13 attached to this letter. The areas designated were based on very general concepts of grading, drainage and protection of natural vegetation. The concepts assumed were as follows:

1) The existing knob or declining ridge located along the proposed roadway noted as Heritage Place would be cut to a maximum depth of 1.5 m and graded. Any material excavated from the ridge would be moved laterally to provide fill for Lot Nos. 1 to 12 of Block 5 and would not be removed to provide fill in other areas.

2) The hilltop to the south of Lots 6 and 7 and to the east of Lot 5 of Block 6 could be cut to the desired depth and used as fill in the lower lying portions of Block 6. A carefull grading plan will especially be required in this area such as to provide proper drainage and to provide accessibility to the residences themselves.

3) All designated fill areas will be stripped of vegetation and deleterious materials prior to placement of such fills. Fills will be properly compacted during placement and under drains will be installed as required to provide for drainage from the slopes.

4) The recommendations and information included in our report S83-1606 are still relevent and apply to the development of this site.

It will be necessary to review the final purposed grading plan to determine that:

1) slope stability is not adversely affected

2) proper drainage is provided

3) suitable building sites are provided for

We trust that this satisfactorily responds to your enquirey but, if you should have any questions regarding the contents of this letter, please do not hesitate to contact this office. BBT Geotechnical Consultants Ltd. appreciates the opportunity to have been of continued service.

Yours respectfully,

BBT GEOTECHNICAL CONSULTANTS LTD.

E.D.(Gene) Froc, P. Eng.

A.J. Muir, P. Eng.

EDF:AJM:mt