RYDE MUNICIPAL COUNCIL

INSTABILITY RISK ZONING

RYDE MUNICIPAL COUNCIL

REPORT NO S9378/1-AC MAY, 1991

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in the Geotechnical Sciences

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Your Reference

Our Reference S9378/1-AC PLV:LB

Date 15th May, 1991

The Town Clerk
Ryde Municipal Council
Civic Centre, Devlin Street
RYDE NSW 2112

ATTENTION: MR R NASH

Dear Sir,

RE: INSTABILITY RISK ZONING - RYDE MUNICIPALITY

Please find attached our final report on instability risk zoning of the Ryde Municipality. This report was prepared following comments made by Council in a letter dated 22nd March, 1991 on our draft report of the 29th October, 1990.

Should you have any questions or comments regarding this report please contact the undersigned.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

P J N PELLS

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1.0 INTRODUCTION

In accordance with a proposal presented by Coffey Partners International to the Ryde Municipal Council dated 12th July 1990, a study has been undertaken to allow designation of zones within the municipality having different levels or risk with respect to land instability and erosion potential.

The risk definitions and zone categories which have been adopted for the study are in general accordance with two papers presented in the 1986 Annual Conference of the Local Government Engineers Association of NSW[1,2]. However, the five classes of risk instability given in these papers have been simplified to three classes as defined in Table 1. It should be noted that each class has a simple definition and that associated with each class are development constraints and an assessed damage potential. The levels of assessed damage potential are conceptually similar to those associated with shrink swell foundation movement as defined in AS2870.1-1988.

This report has been prepared following comments made by Council on our draft report prepared in October, 1990. The report presents the results of the study in the form of Geotechnical Zoning Maps.

2.0 STUDY METHODOLOGY

The study has been based on the following input:

- Data on surface geology and soils from the Sydney 1:100,000 Geology and Soils maps;
- Records from 25 site investigations and slope instability studies carried out by the Coffey group in the Ryde municipality over the last 25 years;
- Discussions with Council engineers and building inspectors in relation to previous experience with slope instability in the municipality;
- field inspections were carried out on the 27th September, 1990 and on the 9th & 10th April, 1991. These inspections followed the initial drafting of a 1:15,000 zoning map and two 1:4000 maps and was used to check on the moderate and high risk areas shown on the maps. In addition, local checks were undertaken of the surface geology on Sydney 1:100,000 map.

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1. Pells P.J.N (1986) "Stability and Foundation Assessments for Residential Developments in NSW", LGEA of NSW 81st Conference, p72.

2. Australian Geomechanics Society - Sydney Group (1986), "Geotechnical Risks of Hillside Development, LGEA of NSW 81st Conference, p75.

- Preparation of a draft report on Instability Risk Zoning in the Ryde Municipality (Report No S9378/1-AB, dated 31st October, 1990). Comments and suggestions made by Council on the draft report were received in a letter dated 22nd March, 1991 and incorporated into the final report. 1:4000 slope and instability risk zoning maps were prepared for the Eastwood-Denistone area and the Denistone East - Ryde area, Drawing Nos S9378/1-2 and S9378/1-3, respectively.

3.0 GEOLOGY AND TOPOGRAPHY

The area of the Ryde Municipality is mostly underlain by shales of the Wianamatta group of sediments. The shale country typically forms gently undulating topography with only limited areas having natural slopes steeper than 10 degrees. The shale is almost horizontally bedded and overlies Hawkesbury Sandstone which outcrops in steep cliff faces along the Parramatta and Lane Cove Rivers.

Recent sediments (Quaternary deposits) are associated with inlets along the Parramatta and Lane Cove Rivers. Many of these low lying areas have been used for fill disposal and sports fields have been constructed on the fill in a number of areas. A typical area of Quaternary sediments with overlying manmade fill is the Buffalo Creek Reserve adjacent to the Field of Mars Wildlife Refuge.

Previous experience with instability of natural slopes in the Wianamatta Shales suggests that landslips occur in areas where the slopes are 10 degrees or steeper. This is not to say that instability is not possible in flatter areas because slips can be generated by the construction of fills on the relatively low shear strength weathered shales, or by unsupported cuts in the shales.

Deep seated sliding is rare in the Hawkesbury Sandstone. Instability of natural slopes in this geological sequence usually takes the form of toppling failure of large blocks of sandstone which have become detached from the main rock mass over the geological time scale.

Based on the above observations, the starting point for designating areas of moderate and high risk in the Ryde municipality has been to map areas in the shale where the slopes are greater than 10 degrees and cliffline areas in the Hawkesbury Sandstone. In addition, major fill areas have been recorded. These areas have been taken from airphotos, geological maps, previous investigations undertaken by this company and from information provided by Council officers.

4.0 GEOTECHNICAL ZONING

4.1 Basis for Zoning

The assessment of risk of slope instability has been based on the attached Table 1 "Classification of Risk of Slope Instability", which in turn is based on a paper prepared by the Australian Geomechanics Society entitled "Geotechnical Risks associated with Hillside Development". The paper uses five levels of risk which is intended to be based on a thorough inspection of geotechnical features for an individual property. In the present regional study it is obviously impracticable to provide a similar level of assessment. The study area has therefore been divided into three broad slope instability risk zones with the Lower Risk Zone corresponding to the Classification of 'low to very low risk'. Moderate Risk Zones are considered equivalent to 'medium risk', and the High Risk Zone areas are assessed to have a 'high to very high risk'. The zones are characterised as follows:

LOW RISK ZONE - areas where either the natural slopes are typically less than 10 degrees, or where the surface is underlain at relatively shallow depth by material which is considered to have sufficient strength that the risk of slope failure is low to very low.

MODERATE RISK ZONES - areas where either the natural slopes are typically steeper than 10 degrees or where the surface is underlain by lower strength foundations materials or steep cliffs. **Zone M1** is characterised by slope angles generally in excess of 10° in areas underlain by shale where there is some evidence to indicate concern on the possibility of slope instability. **Zone M2** is characterised by slope angles generally in the range of 5° to 10° in areas underlain by shale, and **Zone M3** is characterised by steep slopes and cliff lines in sandstone terrain.

HIGH RISK ZONE - local areas where the combination of generally steep slopes and low strength foundation materials have either resulted in slope failure or appear to be present to a degree that a higher risk of instability exists.

4.2 The Zone Maps

The results of the study are summarised on a map at a scale of approximately 1:15,000 (Drawing No S9378/1-1). The base plan was provided by Universal Business Directories based on their 1990 mapping of the Ryde Municipality and the scale is close to 1:15750. The zoning map shows the following:

- Boundaries between the major geological units, namely Quaternary sediments, Wianamatta Group and Hawkesbury Sandstone.
- Structural contours along the base of the Wianamatta Group.

- Instability risk zones, namely LOW, MODERATE and HIGH in accordance with Table 1.

- Large areas of manmade fill.

As requested, to assist Council in processing Development Applications or Building Applications, the areas of Moderate Risk (Zones M1 and M2) in the Eastwood, Denistone and Ryde areas have been plotted onto two 1:4000 plans, using the 1:4000 Orthophotomap series of the area as base plans. (See Drawing Nos S9378/1-2 and S9378/1-3).

It must be accepted that the boundaries shown between the slope instability risk zones are approximate and that it cannot be excluded that slope instability problems may exist, or may be created by development outside of the zoned areas. A certain degree of judgement has been applied in drawing zone boundaries so as not to make them excessively conservative. It is considered that areas adjacent to a zone boundary should be regarded with caution and at least, those properties crossed by a boundary should be regarded as lying within the higher risk zone.

4.3 Use of Zone Maps

Low Risk Zone

It is considered that development of areas designated at Low Risk is unlikely to be affected by slope failure problems due to natural features. Specific geotechnical investigations of these areas is not considered necessary unless development involves major slope modifications.

Moderate Risk Zone

Areas designated as Moderate Risk (i.e areas M1 and M2) exhibit sufficiently steep slopes and residual/slopewash cover overlying shale, that some concern exists on the possibility of slope instability, particularly in the case of uncontrolled development.

Zone M1

It is recommended that in areas designated M1, where slope angles generally exceed 10°, and where there is some evidence to indicate concern on the possibility of slope instability, proposed development should be subject to geotechnical assessment by a suitably qualified Geotechnical Engineer or Engineering Geologist. This should involve an initial inspection of surface features, with subsurface investigations required where conditions are confirmed to be adverse.

Zone M2

In areas designated M2, where slope angles are generally in the range of 5° to 10°, it is recommended that Council officers initially assess whether individual building applications warrant geotechnical assessment. In these

areas it is generally recommended that the height of uncontrolled fill and excavations be restricted to a maximum of 1 metre, unless supported by an engineered retaining structure. In addition, structures in these areas should be founded on weathered shale, below any residual/slopewash materials.

Zone M3

The development of areas designated as Moderate Risk (M3) located on steep slopes and cliff lines in sandstone terrain, should ensure that structures are founded on in-situ sandstone, not potentially unstable detached blocks of sandstone. Where development is proposed adjacent to a steep escarpment it is recommended that the proposed development be initially assessed by Council officers who would decide whether or not a geotechnical assessment is required. As the majority of the areas designed as M3 fall within the Lane Cove River State Recreation Area, such investigations would be rarely required.

High Risk Zone

In the areas designated High Risk, where features indicate active, recent or potential slope instability, development should be regarded with concern. It is recommended that any proposed development within these areas, should be subject to a geotechnical investigation of surface features supported by subsurface investigation to define the geotechnical parameters which are required to more accurately define the degree of risk associated with such development.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used*:

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer*

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A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT*

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by The Institution of Engineers Australia, National Headquarters, Canberra, 1987.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

Published by

ASFE THE ASSOCIATION OF ENGINEERING FIRMS PRACTICING IN THE GEOSCIENCES

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TABLE 1. CLASSIFICATION OF RISK OF SLOPE INSTABILITY

ASSESSMENT OF RISK

A landslip (or landslide) is a downslope movement of a soil or rock mass as a result of shear failure at the boundaries of the moving mass. The dominant movement is lateral and failure takes place over a relatively short period. Soil creep, which is slow and occurs without a well defined failure surface, is not included as a landslip.

Natural hill slopes are formed by processes which reflect the site geology, environment and climate. These processes include downslope movement of the near surface soil and rocks; in geological time all slopes are unstable. The area of influence of these downslope movements may range from local to regional and are rarely related to property boundaries. The natural processes may be affected by human intervention in the form of construction and related activities.

It is not technically feasible to assess the stability of a particular site in absolute terms such as stable or unstable. However the degree of risk of slope movement can be assessed by the recognition of surface features supplemented by limited information on the regional and local subsurface profile and with the benefit of experience gained in similar geological environments. The degree of risk is categorised below.

CLASSIFICATION OF RISK OF LANDSLIP WITHOUT DEVELOPMENT

CLASS	EXPLANATION
LOW	A landslip is very unlikely
MODERATE	A landslip is unlikely
HIGH	There is some risk of a landslip

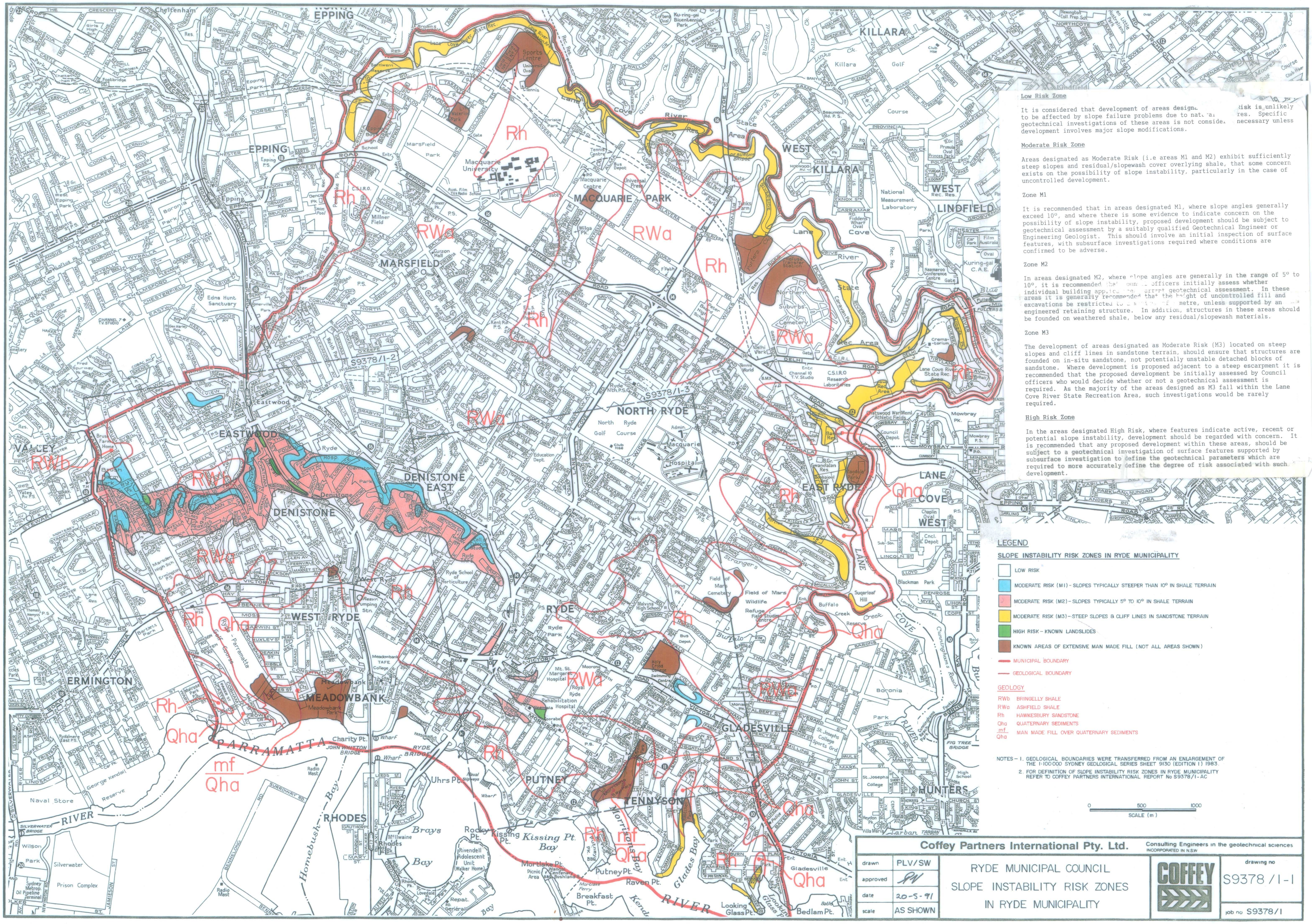
CONSEQUENCES OF HILLSIDE CONSTRUCTION

It must be accepted that the risks associated with hillside construction are greater than construction on level ground in the same geological environment. The impact of development may be adverse and imprudent construction techniques can increase the potential for movement.

Australian Standard AS 2870 - 1986 provides a damage classification that relates to essentially vertical movements of masonry walls and is thus not directly applicable to hillside movements. In the absence of a suitable classification for hillside movements the range of damage categories from negligible to very severe can be used as a general guide for damage potential related solely to landslip.

CLASS	DEVELOPMENT CONSTRAINTS	DAMAGE POTENTIAL EXTENT	DAMAGE POTENTIAL PROBABILITY
LOW	Good Hillside Practice	Slight	Very Low
MODERATE	Good Hillside Practice and site specific restrictions	Slight Moderate	Low Very Low
HIGH	No development unless major engineering remedial works	Moderate Severe	High Moderate

Damage to structures may occur due to a number of causes additional to that attributable to landslip. In the absence of a landslip slight damage might be expected even for good construction. If a landslip occurs damage would probably reach at least a moderate level.



Low Risk Zone

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Zone M2

In areas designated M2, where slope angles are generally in the range of 5° to 10°, it is recommended that [illegible] officers initially assess whether individual building appl[illegible] [illegible] geotechnical assessment. In these areas it is generally recommended that the height of uncontrolled fill and excavations be restricted [illegible] metre, unless supported by an engineered retaining structure. In addition, structures in these areas should be founded on weathered shale, below any residual/slopewash materials.

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LEGEND

SLOPE INSTABILITY RISK ZONES IN RYDE MUNICIPALITY

- LOW RISK
- MODERATE RISK (M1) - SLOPES TYPICALLY STEEPER THAN 10° IN SHALE TERRAIN
- MODERATE RISK (M2) - SLOPES TYPICALLY 5° TO 10° IN SHALE TERRAIN
- MODERATE RISK (M3) - STEEP SLOPES & CLIFF LINES IN SANDSTONE TERRAIN
- HIGH RISK - KNOWN LANDSLIDES
- KNOWN AREAS OF EXTENSIVE MAN MADE FILL (NOT ALL AREAS SHOWN)
- MUNICIPAL BOUNDARY
- GEOLOGICAL BOUNDARY

GEOLOGY

- RWb BRINGELLY SHALE
- RWa ASHFIELD SHALE
- Rh HAWKESBURY SANDSTONE
- Qha QUATERNARY SEDIMENTS
- mf/Qha MAN MADE FILL OVER QUATERNARY SEDIMENTS

NOTES - 1. GEOLOGICAL BOUNDARIES WERE TRANSFERRED FROM AN ENLARGEMENT OF THE 1:100 000 SYDNEY GEOLOGICAL SERIES SHEET 9130 (EDITION 1) 1983.

2. FOR DEFINITION OF SLOPE INSTABILITY RISK ZONES IN RYDE MUNICIPALITY REFER TO COFFEY PARTNERS INTERNATIONAL REPORT No S9378/1-AC

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SCALE (m)

Coffey Partners International Pty. Ltd. Consulting Engineers in the geotechnical sciences INCORPORATED IN N.S.W

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