Our ref: 7407-R1 Rev2
8 March 2025

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Kosciuszko Thredbo Pty Ltd
1 Friday Drive
Thredbo NSW 2625

Attention: Kyra O'Sullivan

Dear Kyra,

Proposed New Water & Sewer Services Installation, Lots 793, 794 & 795, Diggins Terrace, Thredbo Village NSW
Geotechnical Assessment

1. Introduction

1.1 General

This report presents the results of a geotechnical assessment for Proposed new Water and Sewer Services Installation for Lot 793 (Sashas Apartments) Lot 794 (Blackbear Lodge) and Lot 795 (Candlelight Lodge), Diggins Terrace, Thredbo Village NSW (the Site). The assessment was commissioned by Kyra O'Sullivan of Kosciuszko Thredbo Pty Ltd. Preliminary comments were provided in our memo dated 30 November 2023, ref: 7047-M1. This report is updated to reflect the revised sewer main plans.

Drawings supplied to us for this assessment comprised:

- Hydraulic Services Plans (by Scott Harris & Associates Pty Ltd, reference 2023048, drawings H0-01(C) dated 7/3/25, H1-01(E) dated 7/3/25, H1-02(B) dated 9/7/24, H1-03(A) dated 7/3/24).
- Site Plan (by Thredbo, project GIS2418, revision H, dated 7/3/25).

Based on the supplied drawings, we understand that the project involves:

Sewer

- Making existing Ø150mm sewer at the rear of Sashas Apartment redundant.
- Make section of existing Ø150mm sewer at the rear of Candlelight redundant.
- Lay new Ø150mm uPVC sewer main from the rear of Candlelight to near the rear boundary and continue along the rear boundary of Blackbear and Sashas to connect to the existing sewer in the void underneath Squatters Run carpark. Sewer grade to vary from 3.75% to 7%, and depth to sewer generally less than about 1m depth but up to about 1.76m depth at the rear of Sashas Apartments adjacent to Squatters carpark.

Water

- Make new water connection and extend install with path valve, make new tee and valve connection as required for connection to Black Bear site domestic and fire hydrant water supply provisions.

- Based on the supplied trench detail drawing, it is understood that a Ø160mm water main is to be installed in a single trench nominally 300mm wide with minimum 450mm cover, total trench depth nominal 910mm, excavation of up to 1m is expected.

The site is within the "G" area as per Department of Infrastructure, Planning and Natural Resources "Geotechnical Policy – Kosciuszko Alpine Resorts". However, the development is of minor impact and therefore a Minor Impact Certification is required instead of a full geotechnical report.

1.2 Scope of Work

The main objective of the assessment is to provide information on the surface conditions and likely subsurface conditions, and to provide a Site Classification to AS2870-2011 'Residential Slabs and Footings' and a Form 4 – Minimal Impact Certification with design recommendations.

The following scope of work was carried out to achieve the project objectives:

- A review of existing regional maps and reports relevant to the Site held within our files.
- Visual observations of surface features through provided site photos and site inspection by a Senior Principal Geotechnical Engineer on 27 October 2023.
- Review of supplied technical drawings.
- Engineering assessment and reporting.

This report must be read in conjunction with the attached "Important Information about your Geotechnical Report" in Appendix A. Attention is drawn to the limitations inherent in site investigations and the importance of verifying the subsurface conditions inferred herein.

2. Regional Topography & Site Geology

The regional topography comprises moderately to steeply sloping terrain flanking the north-easterly flowing Thredbo River, with ground slopes over the land flanking the river generally ranging from 10° to 30° and some locally steeper sections, and more gentle slopes over the river shoulders. Numerous drainage depressions and watercourses flow towards the river, with some of the persistent watercourses to the north of the river carved several metres into the underlying granite bedrock. Side slopes to creeks and watercourses are typically steeper at 20 to 35°, and typically include numerous granite boulders and cobbles.

The 1:250,000 Tallangatta Geological Map indicates the site is underlain by Silurian aged intrusive granite.

3. Site Observation & Likely Subsurface Conditions

The ground surface over the site locality slopes to the north at up to about 10° to 15°. Existing lodges and apartments are located within the front part of the each of the lots, with grassed area at the rear.

The majority of the works for the proposed new sewer line will be carried out at the rear of existing development includes Sashas Apartments, Black Bear Inn, Candlelight Lodge, and Squatters. Selected photos are attached.

The works for new water main will mostly happened along Diggings Terrace to Banjo Drive and connections to the front of the lots.

It is anticipated that excavation for the trench would be through topsoil and a competent subsurface profile comprising residual soils and possibly into completely weathered granite.

4. Discussions & Recommendations

4.1 Earthworks

The following recommendations are provided for the development:

- Excavation is anticipated to be predominantly within soils of variable nature including fill and possibly completely weathered granite and cobbles and boulders. Excavation could be achieved by suitably sized excavator.
- Temporary excavation up to about 1m depth may be cut vertical in clayey soils, and nominally 1H:1V in sands and gravels. Deeper temporary excavations up to about 2m depth should be benched / battered at no steeper than 1.5H:1V, or provided with temporary shoring (e.g., by proprietary box shoring).
- Permanent excavations should be formed no steeper than 2H:1V and should be provided with erosion protection.
- Coring through the footing of the concrete block retaining wall along the western side of Sashas Apartment must be carried out with care to ensure that the retaining wall is not adversely impacted.
- Where filing is required, it should be placed in horizontal layers over prepared subgrade and compact as per Table 1.

Table 1 – Compaction Specifications

Parameter	Cohesive Fill	Non-Cohesive Fill
Fill layer thickness (loose measurement): • Within 1.5m of the rear of retaining walls • Elsewhere	 0.2m 0.3m	 0.2m 0.3m
Density: • Beneath Pavements • Beneath Structures • Upper 150mm of subgrade	 ≥ 95% Std ≥ 98% Std ≥ 100% Std	 ≥ 70% ID ≥ 80% ID ≥ 80% ID
Moisture content during compaction	± 2% of optimum	Moist but not wet

4.2 Subgrade Preparation

Subgrade for pipe laying should be prepared as follows:

- Strip existing fill and topsoil. Remove unsuitable materials from the Site (e.g., material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate soils to design subgrade level, stockpiling for re-use as engineered fill or remove to spoil.
- Compact the upper 150mm depth to a dry density ratio (AS1289.5.4.1–2007) not less than 100% Standard.
- Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill compacted to a dry density ratio not less than 100%.

4.3 Site Classification

Due to the presence of trees, fill, existing site structures (causing abnormal moisture conditions), and landslide risk setting, the Site is classified as a Class P (Problem) Site in accordance with AS 2870–2011 “Residential Slabs and Footings”.

The proposed development does not involve construction of footings, but anchor blocks are proposed at selected locations. A design allowable bearing pressure is not specified. We consider likely that trenches would be excavated down to medium dense or better sandy soils or stiff or better clayey soils, for which an allowable vertical bearing pressure of 100kPa and an allowable lateral bearing pressure of 50kPa may be adopted. Further geotechnical advice must be sought if higher allowable bearing pressures are required, and excavations should be inspected to confirm the design assumptions.

5. Limitations

In addition to the limitations inherent in site investigations (refer to the attached Information Sheets), it must be pointed out that the recommendations in this report are based on assessed subsurface conditions from limited observation.

This report and details for the proposed development should be submitted to relevant regulatory authorities that have an interest in the property (e.g. Department of Planning) or are responsible for services that may be within or adjacent to the site for their review.

Asset accepts no liability where our recommendations are not followed or are only partially followed. The document “Important Information about your Geotechnical Report” in Appendix A provides additional information about the uses and limitations of this report.

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Please do not hesitate to contact the undersigned if you have any questions regarding this report or if you require further assistance.

For and on behalf of
AssetGeoEnviro

Mark Bartel

Mark Bartel
BE, MEngSc, GMQ, CPEng, RPEQ/NER(Civil), DEP/PRE (NSW)
Managing Director | Senior Principal Geotechnical Engineer

Encl: Site Photos
Important Information about your Geotechnical Report
CSIRO BTF 18
Soil and Rock Explanation Sheets
Supplied Plans
Form 4

Document Control

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Document Status

Rev	Revision Details	Date	Author	Reviewer	Approver
0	Initial issue	13 September 2024	TK	MAB	MAB
1	Updated plans	14 February 2025	AM	MAB	MAB
2	Updated plans	8 March 2025	MAB		MAB

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ISO 9001:2015
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Site Photos

Photo 1 – View towards Blackbear Inn (being re-developed) – Sashas Apartments in foreground.

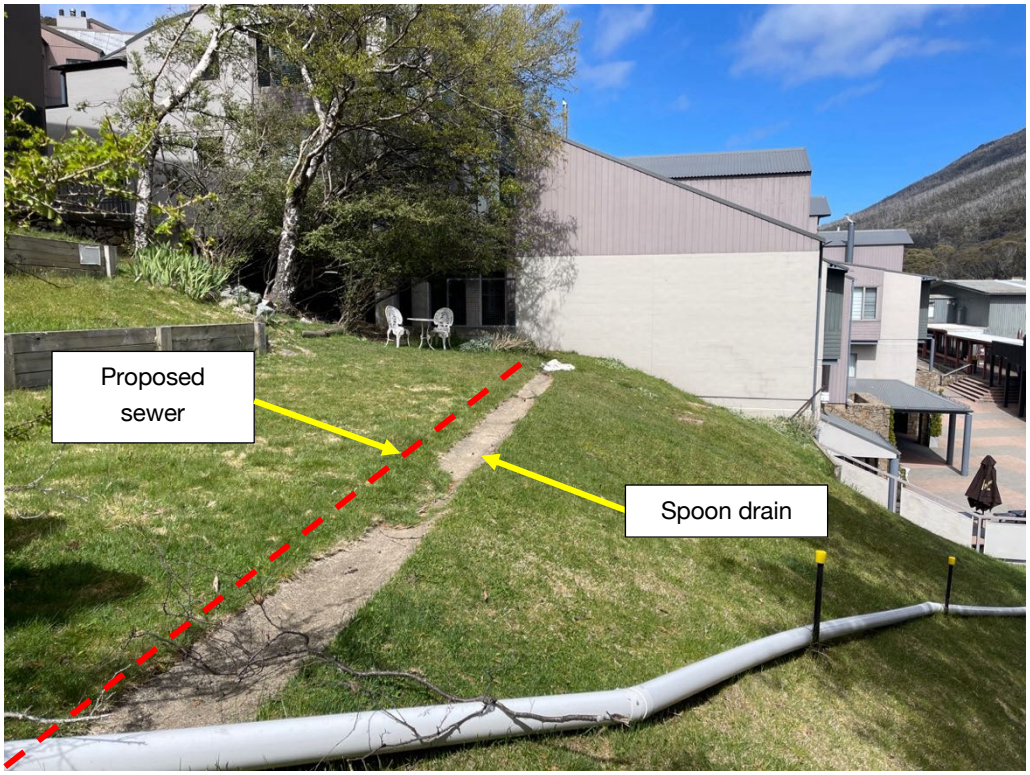


Photo 2 – View of rear of Sashas Apartments showing existing spoon drain and proposed sewer and stormwater.

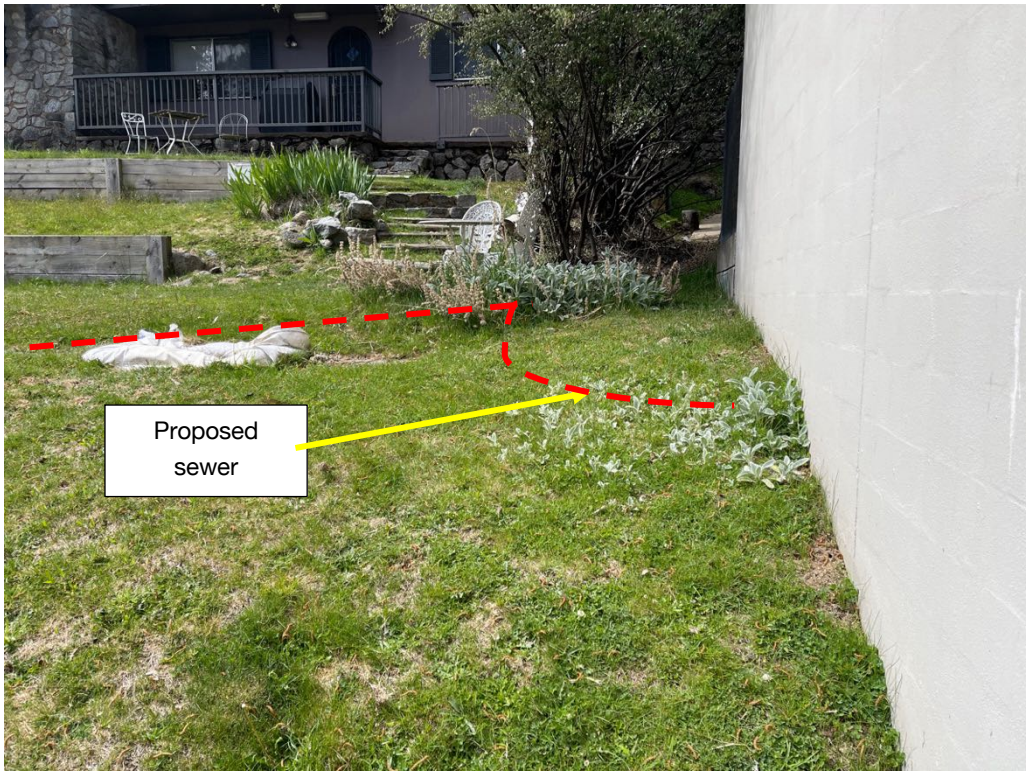


Photo 3 – View of rear of Sashas Apartments showing proposed sewer connection.

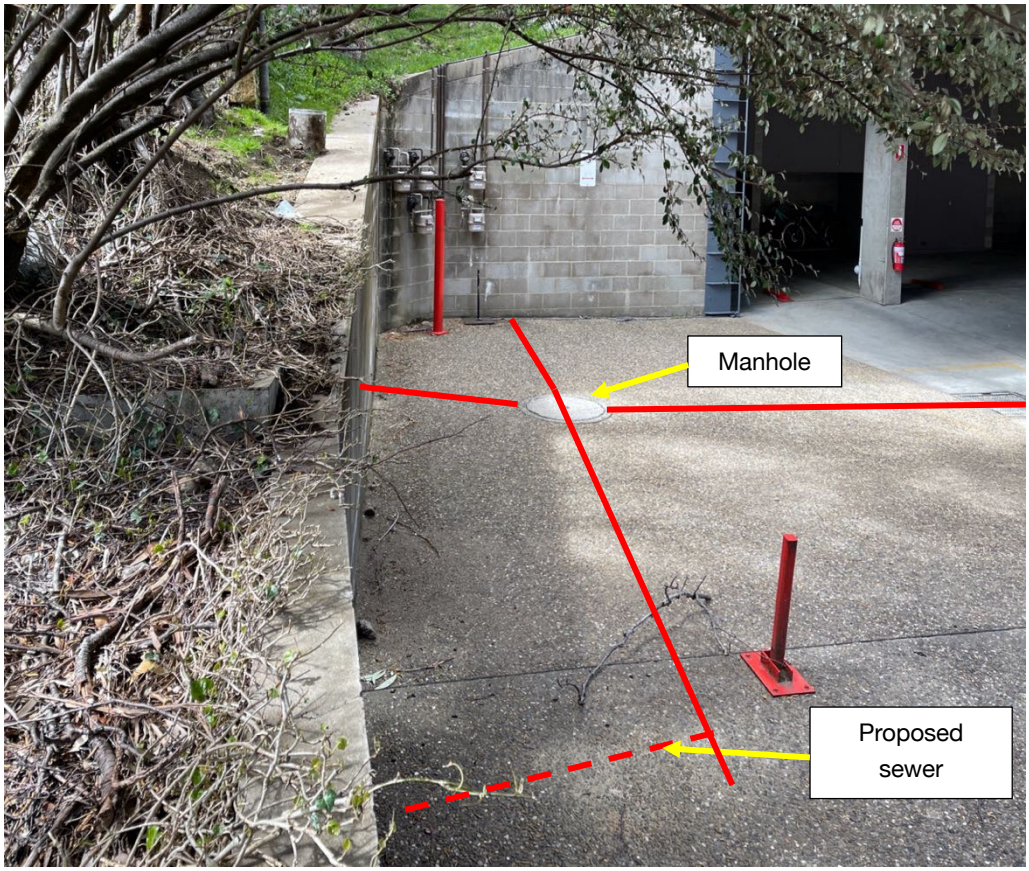


Photo 4 – View of rear of Squatters Run, showing possible sewer

Photo 5 – Closeup view of riser and adjacent manhole.

Photo 6 – View of void behind carpark where sewer will connect to existing (source: Kosciuszko Thredbo Pty Ltd).

Important Information about your Geotechnical Report

Scope of Services

The geotechnical report ("the report") was prepared in accordance with the contractual scope of services between the Client and AssetGeoEnviro ("Asset") for the specific site investigated. The scope of work may have been limited by factors like time, budget, access, or site disturbance.

Consult Asset before using the report if the project has changed. Asset won't be responsible for problems caused by project changes if not consulted.

Reliance on Data

Asset prepared the report using data provided by the Client and other individuals and organizations, including surveys, analyses, designs, maps, and plans. Asset has not verified the accuracy or completeness of the data except as stated in the report. Asset won't be liable for incorrect conclusions based on incorrect data, information, or conditions if they're concealed, withheld, misrepresented, or not fully disclosed.

Geotechnical Engineering

Geotechnical engineering heavily relies on judgment and opinion, making it less precise than other engineering disciplines. Reports are tailored to specific clients, projects, and needs, and may not be suitable for other clients or purposes. The report should only be used for its intended purpose unless additional geotechnical advice is obtained. If further geotechnical advice isn't obtained, the report can't be used if the proposed development's nature or details change.

Limitations of Site Investigation

The investigation program undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behavior regarding the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

Therefore, the recommendations in the report can only be regarded as preliminary. Asset should be retained during the project implementation to assess if the report's recommendations are valid and whether changes should be considered as the project proceeds.

Subsurface Conditions are Time Dependent

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Asset should be kept appraised of any such events and should be consulted to determine if any additional tests are necessary.

Verification of Site Conditions

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Asset be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience, and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

Reproduction of Reports

 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included to minimize the likelihood of misinterpretation from logs.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. Asset assumes no responsibility and will not be liable to any other person or organization for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organization arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Asset or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

Data Must Not Be Separated from The Report

The report presents the site assessment and must not be copied in part or altered in any way.

Logs, figures, drawings, test results etc. included in our reports are developed by professionals based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Report Recommendations not Followed

Where the report's recommendations are not followed, there may be significant implications for the project (e.g., commercial, property, personal, or life loss). Consult Asset if you don't intend to follow all the report recommendations. Asset won't accept responsibility if all the report recommendations aren't followed.

Other Limitations

Asset will not be liable to update or revise the report to consider any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

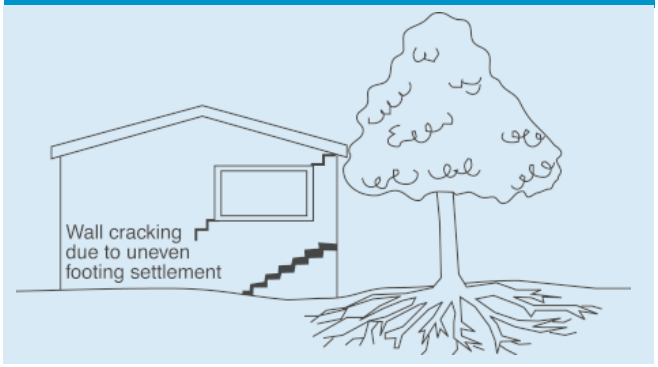
Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

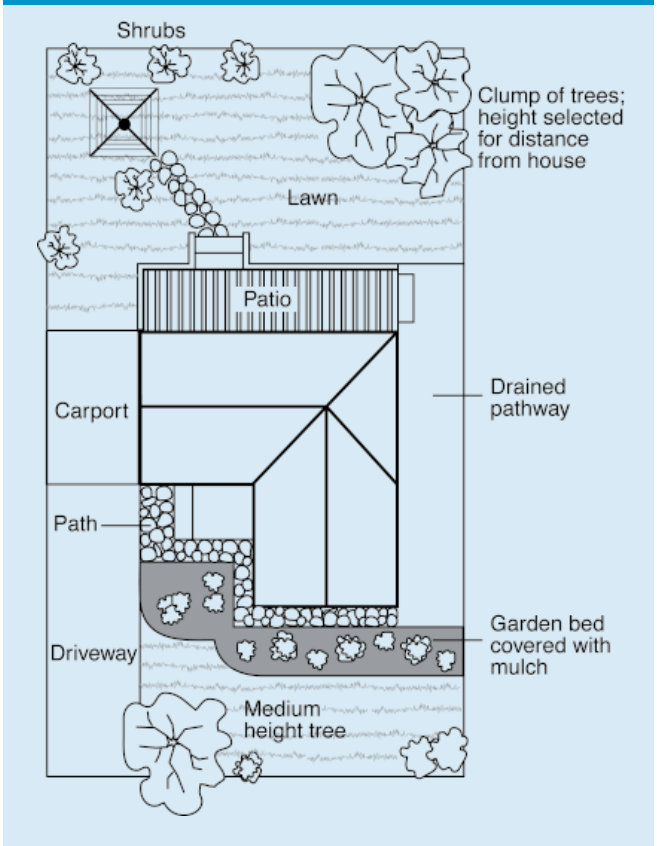
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Soil and Rock Explanation Sheets (1 of 2)

Log Abbreviations & Notes

METHOD

borehole logs		excavation logs	
AS	auger screw *	NE	natural excavation
AD	auger drill *	HE	hand excavation
RR	roller / tricone	BH	backhoe bucket
W	washbore	EX	excavator bucket
CT	cable tool	DZ	dozer blade
HA	hand auger	R	ripper tooth
D	diatube		
B	blade / blank bit		
V	V-bit		
T	TC-bit		

* bit shown by suffix e.g. ADV

coring
NMLC, NQ, PQ, HQ

SUPPORT

borehole logs		*excavation logs*	
N	nil	N	nil
M	mud	S	shoring
C	casing	B	benched
NQ	NQ rods		

CORE—LIFT

‖	casing installed
⊢	barrel withdrawn

NOTES, SAMPLES, TESTS

D	disturbed
B	bulk disturbed
U50	thin-walled sample, 50mm diameter
HP	hand penetrometer (kPa)
SV	shear vane test (kPa)
DCP	dynamic cone penetrometer (blows per 100mm penetration)
SPT	standard penetration test
N*	SPT value (blows per 300mm)
	* denotes sample taken
Nc	SPT with solid cone
R	refusal of DCP or SPT

USCS SYMBOLS

GW	Gravel and gravel-sand mixtures, little or no fines.
GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels
GM	Gravel-silt mixtures and gravel-sand-silt mixtures.
GC	Gravel-clay mixtures and gravel-sand-clay mixtures.
SW	Sand and gravel-sand mixtures, little or no fines.
SP	Sand and gravel sand mixtures, little or no fines.
SM	Sand-silt mixtures.
SC	Sand-clay mixtures.
ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays.
OL	Organic silts
MH	Inorganic silts
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity, organic silt
PT	Peat, highly organic soils.

MOISTURE CONDITION

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

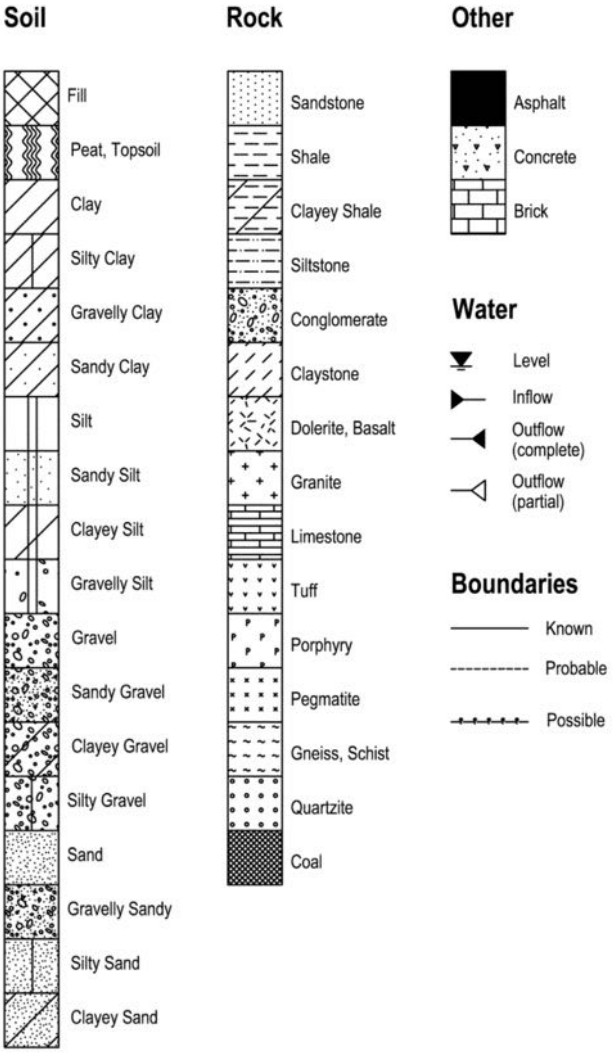
CONSISTENCY

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable

DENSITY INDEX

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Graphic Log



WEATHERING

XW	extremely weathered
HW	highly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

STRENGTH

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

RQD (%)

= sum of intact core pieces > 2 x diameter x 100
total length of core run drilled

DEFECTS:

type		*coating*	
JT	joint	cl	clean
PT	parting	st	stained
SZ	shear zone	ve	veneer
SM	seam	co	coating

shape		*roughness*	
pl	planar	po	polished
cu	curved	sl	slickensided
un	undulating	sm	smooth
st	stepped	ro	rough
ir	irregular	vr	very rough

inclination
measured above axis and perpendicular to core

Soil and Rock Explanation Sheets (2 of 2)

AS1726–2017

Soils and rock are described in the following terms, which are broadly in accordance with AS1726–2017.

Soil

MOISTURE CONDITION

Term	Description
Dry	Looks and feels dry. Fine grained and cemented soils are hard, friable or powdery. Uncemented coarse grained soils run freely through hand.
Moist	Soil feels cool and darkened in colour. Fine grained soils can be molded. Coarse soils tend to cohere.
Wet	As for moist, but with free water forming on hand.

Moisture content of cohesive soils may also be described in relation to plastic limit (W_P) or liquid limit (W_L) [>> much greater than, > greater than, < less than, << much less than].

CONSISTENCY OF FINE-GRAINED SOILS

Term	Su (kPa)	Term	Su (kPa)
Very soft	< 12	Very Stiff	>100 – ≤200
Soft	>12 – ≤25	Hard	> 200
Firm	>25 – ≤50	Friable	–
Stiff	>50 – ≤100		

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Term	Density Index (%)	Term	Density Index (%)
Very Loose	< 15	Dense	65 – 85
Loose	15 – 35	Very Dense	>85
Medium Dense	35 – 65		

PARTICLE SIZE

Name	Subdivision	Size (mm)
Boulders		> 200
Cobbles		63 – 200
Gravel	coarse	19 – 63
	medium	6.7 – 19
	fine	2.36 – 6.7
Sand	coarse	0.6 – 2.36
	medium	0.21 – 0.6
	fine	0.075 – 0.21
Silt		0.002 – 0.075
Clay		< 0.075

MATERIAL DELINEATION

Sand or gravel	>65% above 0.075mm
Clay or silt	>35% below 0.075mm

MINOR COMPONENTS

Term	Proportion by Mass: *coarse grained*	*fine grained*
Trace	≤ 5%	≤ 5%
With	>15% ≤ 30%	>5% – ≤12%

SOIL ZONING

Layers	Continuous across exposures or sample.
Lenses	Discontinuous, lenticular shaped zones.
Pockets	Irregular shape zones of different material.

SOIL CEMENTING

Weakly	Easily broken up by hand pressure in water or air.
Moderately	Effort is required to break up by hand in water or in air.

USCS SYMBOLS

Symbol	Description
GW	Gravel and gravel-sand mixtures, little or no fines.
GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels.
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OL	Organic silts
MH	Inorganic silts
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity, organic silt
PT	Peat, highly organic soils.

Rock

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition (more than 50% of rock consists of …..)
Conglomerate	... gravel sized (>2mm) fragments.
Sandstone	... sand sized (0.06 to 2mm) grains.
Siltstone	... silt sized (<0.06mm) particles, rock is not laminated.
Claystone	... clay, rock is not laminated.
Shale	... silt or clay sized particles, rock is laminated.

LAYERING

Term	Description
Massive	No layering apparent.
Poorly Developed	Layering just visible. Little effect on properties.
Well Developed	Layering distinct. Rock breaks more easily parallel to layering.

STRUCTURE

Term	Spacing (mm)	Term	Spacing
Thinly laminated	<6	Medium bedded	200 – 600
Laminated	6 – 20	Thickly bedded	600 – 2,000
Very thinly bedded	20 – 60	Very thickly bedded	> 2,000
Thinly bedded	60 – 200		

STRENGTH (NOTE: Is50 = Point Load Strength Index)

Term	Is50 (MPa)	Term	Is50 (MPa)
Very Low	0.03 – 0.1	High	1.0 – 3.0
Low	0.1 – 0.3	Very High	3.0 – 10.0
Medium	0.3 – 1.0	Extremely High	>10.0

WEATHERING

Term	Description
Residual Soil	Material is weathered to an extent that it has soil properties. Rock structures are no longer visible, but the soil has not been significantly transported.
Extremely …..	Material is weathered to the extent that it has soil properties. Mass structures, material texture & fabric of original rock is still visible.
Highly …..	Rock strength is significantly changed by weathering; rock is discolored, usually by iron staining or bleaching. Some primary minerals have weathered to clay minerals.
Moderately …..	Rock strength shows little or no change of strength from fresh rock; rock may be discolored.
Slightly …..	Rock is partially discolored but shows little or no change of strength from fresh rock.
Fresh	Rock shows no signs of decomposition or staining.

DEFECT DESCRIPTION

Type	
Joint	A surface or crack across which the rock has little or no tensile strength. May be open or closed.
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/bedding. May be open or closed.
Sheared Zone	Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects.
Seam	Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed).
Shape	
Planar	Consistent orientation.
Curved	Gradual change in orientation.
Undulating	Wavy surface.
Stepped	One or more well defined steps.
Irregular	Many sharp changes in orientation.
Roughness	
Polished	Shiny smooth surface.
Slickensided	Grooved or striated surface, usually polished.
Smooth	Smooth to touch. Few or no surface irregularities.
Rough	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper.
Very Rough	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper.
Coating	
Clean	No visible coating or discolouring.
Stained	No visible coating but surfaces are discolored.
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	Visible coating =1mm thick. Thicker soil material described as seam.

KOSCIUSZKO THREDBO
LOTS 794 (BLACKBEAR) & 795 (CANDLELIGHT)
SEWER AND WATER SERVICING PROVISIONS

GENERAL SPECIFICATION NOTES

GN1 ALL WORKS SHALL BE CO-ORDINATED AND APPROVED BY KOSCIUSZKO THREDBO (KT) ENGINEERING DEPARTMENT AND INSTALLED AS PER KT GUIDELINES

GN2 SUB CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS, SERVICES AND STRUCTURES ON SITE PRIOR TO COMMENCEMENT OF WORK.

GN3 SUB CONTRACTOR SHALL ARRANGE FOR ALL SURVEY SETOUT TO BE CAR RIEDOUT BY A REGISTERED SURVEYOR.

GN4 ON COMPLETION OF PROPOSED WORKS ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AND GRASSED AREAS AND ROAD PAVEMENTS UNLESS NOTED OTHERWISE.

GN5 MAKE SMOOTH TRANSITION TO EXISTING SERVICES AND MAKE GOOD WHERE REQUIRED.

GN6 WHERE NEW WORKS ABUT EXISTING THE SUB CONTRACTOR SHALL ENSURE THAT A SMOOTH EVEN PROFILE, FREE FROM ABRUPT CHANGES IS OBTAINED.

GN7 CARE IS TO BE TAKEN WHEN EXCAVATING NEAR EXISTING SERVICES. NO MECHANICAL EXCAVATIONS ARE TO BE UNDERTAKEN OVER OR IN CLOSE PROXIMITY TO THESE SERVICES. HAND EXCAVATE IN THESE AREAS.

GN8 THESE PLANS SHALL BE READ IN CONJUNCTION WITH APPROVED ARCHITECTURAL, CIVIL, STRUCTURAL, MECHANICAL, ELECTRICAL AND COMMUNICATION/SECURITY DRAWINGS AND SPECIFICATIONS.

GN9 SUB CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS VARIOUS PIPE ADAPTORS TO ENSURE PROPER NON CORROSIVE CONNECTION BETWEEN DISSIMILAR PIPEWORK.

GN10 ALL ELEVATED SERVICES PIPEWORK SHALL BE CLEARLY LABELLED IN ACCORDANCE WITH REQUIREMENTS OF AS3500:2003 - AS 2419-2021 AND AS1345:1995.

GN11 ALL SERVICES SHALL BE CHARGED AND TESTED PRIOR TO CONCEALMENT.

GN12 ALL SERVICE SHOWN ARE INDICATIVE ONLY AND FINAL PIPE DETAILS AND LOCATIONS ARE TO BE OBTAINED BY THE SUB CONTRACTOR CO-ORDINATING WITH AND GAINING CONFIRMATION FROM THE RELEVANT SERVICES.

GN13 ELECTRICAL CONDUITS FOR HYDRAULIC SERVICES PLANT & EQUIPMENT SHALL BE ORANGE HEAVY DUTY RIGID TYPE IN ACCORDANCE WITH CATEGORY 'A' OF AS3000 AND AS DESCRIBED IN THE ELECTRICAL SPECIFICATION AND DOCUMENTATION.

GN14 WHERE REQUIRED CONCRETE THRUST BLOCKS SHALL BE CONSTRUCTED TO ALL BENDS, T's, END POINTS AND ALL OTHER FITTINGS THAT MAY IMPART LOADS INTO THE ADJACENT GROUND. THRUST BLOCKS SHALL BE CONSTRUCTED TO AS3500 REQUIREMENTS AND LOCAL WATER AUTHORITY STANDARDS AND TO SUIT THE BEARING OF THE SOILS IN WHICH THEY ARE CONSTRUCTED.

GN15 ON COMPLETION, ALL PIPEWORK SHALL BE SUBJECT TO A PRESSURE TEST REQUIRED BY MANAGING CONTRACTOR. ANY DEFECTS FOUND IN THE SYSTEM SHALL BE REMEDIED AND THE TEST RE-APPLIED.

GN16 PIPEWORK RETICULATING / PASSING THROUGH PLAY ROOMS, PLAY AREA'S, COT ROOMS, ENCLOSED AREAS AND AREAS NOMINATED BY THE ACOUSTIC CONSULTANT SHALL BE ACOUSTICALLY INSULATED TO SATISFY THE NATIONAL CONSTRUCTION CODE (NCC) AND ACOUSTIC ENGINEER'S REQUIREMENTS.

GN17 TRENCHES THROUGH EXISTING ROAD AND CONCRETE AREAS SHALL BE SAWCUT TO FULL DEPTH OF CONCRETE AND A MINIMUM OF 50mm IN BITUMINOUS PAVING. REINSTATE WITH ADDITIONAL REINFORCEMENT AND DOWELLING AS REQUIRED BY STRUCTURAL ENGINEERS.

GN18 SUB CONTRACTOR SHALL PROVIDE ALL TIMBERING, SHORING AND SHUTTERING AS NECESSARY TO CONSTRUCT PIPEWORK INCLUDING THE REMOVAL OF SAME UPON COMPLETION OF PIPEWORK.

GN19 SUB CONTRACTOR SHALL OBTAIN ALL AUTHORITY APPROVALS AND PAY ALL FEES.

GN20 ALL WORK TO BE IN ACCORDANCE WITH LOCALE WATER SUPPLY AUTHORITY, FIRE AND RESCUE NSW, AS3500, AS2118, AS2444, AS2419 AND RELATED STANDARDS AS APPROPRIATE.

GN21 SUB CONTRACTOR TO PROVIDE 'AS BUILT' DOCUMENTATION UPON PRACTICAL COMPLETION OF THE PROJECT AND SHALL BE IN CAD FORMAT (AUTOCAD).

GN22 ORIGIN OF LEVELS:-AUSTRALIAN HEIGHT DATUM AND SHALL BE CONFIRMED ON SITE.

GN23 ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.

GN24 ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH SAND OR AN APPROVED GRANULAR MATERIAL AND COMPACTED TO 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS1289 E1.1.

GN25 ALL SERVICES THAT CROSS FOOTINGS ETC. SHALL BE BACKFILLED WITHGRANULAR MATERIAL TO SUBGRADE LEVEL AND COMPACTED TO 95% M.M.D.D.

GN26 PIPEWORK ADJACENT TO BUILDING STRUCTURE SHALL BE INSTALLED AS PER DETAIL 4 AND/OR STRUCTURAL ENGINEERING APPROVALS

EARTHWORKS NOTES

THE FOLLOWING RECOMMENDATIONS ARE PROVIDED FOR THE DEVELOPMENT: ALL WORKS SHALL BE COMPLETED IN ACCORDANCE WITH PROJECT SPECIFIC GEOTECH REPORT

1) EXCAVATION IS ANTICIPATED TO BE PREDOMINANTLY WITHIN SOILS OF VARIABLE NATURE INCLUDING FILL AND POSSIBLY COMPLETELY WEATHERED GRANITE AND COBBLES AND BOULDERS. EXCAVATION COULD BE ACHIEVED BY SUITABLY SIZED EXCAVATOR.
2) TEMPORARY EXCAVATION UP TO ABOUT 1M DEPTH MAY BE CUT VERTICAL IN CLAYEY SOILS, AND NOMINALLY 1H:1V IN SANDS AND GRAVELS. DEEPER TEMPORARY EXCAVATIONS UP TO ABOUT 2M DEPTH SHOULD BE BENCHED / BATTERED AT NO STEEPER THAN 1.5H:1V, OR PROVIDED WITH TEMPORARY SHORING (E.G., BY PROPRIETARY BOX SHORING).
3) PERMANENT EXCAVATIONS SHOULD BE FORMED NO STEEPER THAN 2H:1V AND SHOULD BE PROVIDED WITH EROSION PROTECTION.
4) CORING THROUGH THE FOOTING OF THE CONCRETE BLOCK RETAINING WALL ALONG THE WESTERN SIDE OF SASHAS APARTMENT MUST BE CARRIED OUT WITH CARE TO ENSURE THAT THE RETAINING WALL IS NOT ADVERSELY IMPACTED.
5) WHERE FILING IS REQUIRED, IT SHOULD BE PLACED IN HORIZONTAL LAYERS OVER PREPARED SUBGRADE AND COMPACT AS PER TABLE 1 BELOW.

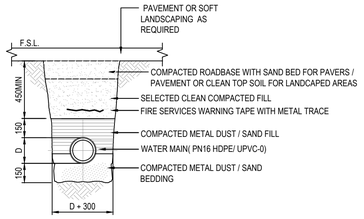
Table 1 – Compaction Specifications

Parameter	Cohesive Fill	Non-Cohesive Fill
Fill layer thickness (loose measurement):		
• Within 1.5m of the rear of retaining walls	0.2m	0.2m
• Elsewhere	0.3m	0.3m
Density:		
• Beneath Pavements	≥ 95% Std	≥ 70% ID
• Beneath Structures	≥ 98% Std	≥ 80% ID
• Upper 150mm of subgrade	≥ 100% Std	≥ 80% ID
Moisture content during compaction	± 2% of optimum	Moist but not wet

SUBGRADE PREPARATION

SUBGRADE FOR PIPE LAYING SHOULD BE PREPARED AS FOLLOWS:

6) STRIP EXISTING FILL AND TOPSOIL. REMOVE UNSUITABLE MATERIALS FROM THE SITE (E.G., MATERIAL CONTAINING DELETERIOUS MATTER). STOCKPILE REMAINDER FOR RE-USE AS LANDSCAPING MATERIAL OR REMOVE FROM SITE.
7) EXCAVATE SOILS TO DESIGN SUBGRADE LEVEL, STOCKPILING FOR RE-USE AS ENGINEERED FILL OR REMOVE TO SPOIL.
8) COMPACT THE UPPER 150MM DEPTH TO A DRY DENSITY RATIO (AS1289.5.4.1–2007) NOT LESS THAN 100% STANDARD.
9) AREAS WHICH SHOW VISIBLE HEAVE UNDER COMPACTION EQUIPMENT SHOULD BE OVER-EXCAVATED A FURTHER 0.3M AND REPLACED WITH APPROVED FILL COMPACTED TO A DRY DENSITY RATIO NOT LESS THAN 100%.



DETAIL 1- TRENCH DETAIL
NTS.

DRAWING LIST

WATER SERVICES NOTES

1) ALL WORKS TO BE COMPLETED AS DETAILED AND IN ACCORDANCE WITH , AS-3500- 1, WATER SERVICES ASSOCIATION OF AUSTRALIA WATER SUPPLY CODE AND RELEVANT AUSTRALIAN / AUTHORITY STANDARDS

2) ALLOW TO CO-ORDINATE NEW SITE PROVISIONS WITH BLACKBEAR SITE CONTRACTORS

SEWER DRAINAGE SERVCIES NOTES

1) ALL WORKS TO BE COMPLETED AS DETAILED AND IN ACCORDANCE WITH , AS-3500- 2 AND WATER SERVICES ASSOCIATION OF AUSTRALIA SEWERAGE DRAINAGE CODE AND RELEVANT AUSTRALIAN / AUTHORITY STANDARDS

2) ALLOW TO CO-ORDINATE NEW SITE CONNECTION PROVISIONS WITH BLACKBEAR AND CANDLELIGHT SITE CONTRACTORS

MATERIAL SCHEDULE

WATER SERVICES	IN GROUND : Ø110 PN16 HDPE PRESSURE PIPE WITH ELECTRO-FUSION FITTINGS. WATER MAIN PIPE WORK TO HAVE WIRE TRACE AS PER DETAIL 1 -H0-01 ABOVE GROUND: Ø110- PRE INSULATED PIPING EQUAL TO PERMAPIPE (PH 07 3200 2801) WITH PN16 HDPE CARRIER PIPE, CLOSED CELL RIDGED POLYURETHANE INSULATION WITH LOCKED SEAM GALVANIZED STEEL METAL SHEATH OUTER CASING AS PER DETAIL 6 H2-01
SEWER SERVICES	IN GROUND: Ø150 UPVC DWV CLASS EQUAL TO AS/NS1260 WITH SOLVENT WELD FITTING

LEGEND

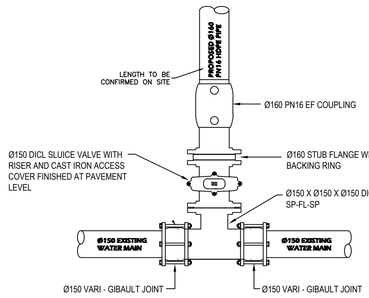
WATER SERVICES
SEWER DRAINAGE SERVICES
EXISTING WATER SERVICE
EXISTING SEWER DRAINAGE
EXISTING ELECTRICAL

CW COLD WATER
E EXISTING
FH FIRE HYDRANT
FHR FIRE HOSE REEL
HL HIGH LEVEL
HT HOSE TAP
IL INVERT LEVEL
RL REDUCED LEVEL
ø RISER
† DROPPER
PIPE DIAMETER
HOSE TAP

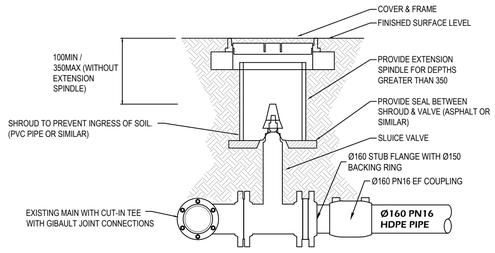
STOP VALVE
CHECK CALVE
STOP VALVE IN PATH BOX
FLOW DIRECTION
FIRE HOSE REEL
FIRE HYDRANT
METER
PUMP
TYPE OF SERVICE
SIZE OF SERVICE
DIRECTION OF SERVICE
THRUST BLOCK
HYDRANT BOOSTER ASSEMBLY

NOTE: THIS IS A STANDARD LEGEND. ALL SYMBOLS MAY NOT NECESSARILY BE USED IN THESE DRAWINGS.

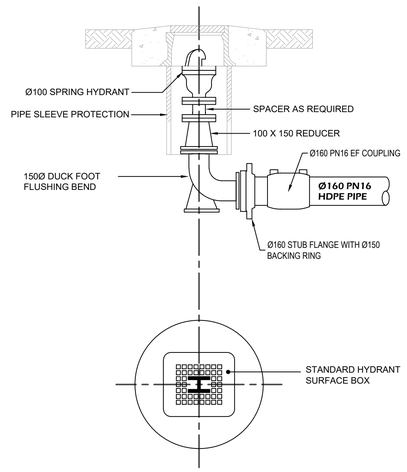
WARNING
CO-ORDINATE WITH EXISTING IN GROUND SERVICES



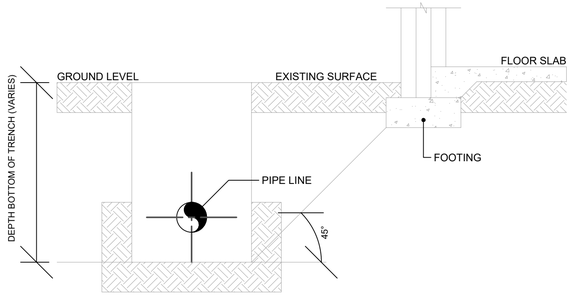
PLAN VIEW



DETAIL 2 150mm CONNECTION WITH SLUICE VALVE INSTALLATION
N.T.S.



DETAIL 3: Ø100 SPRING PATH FLUSHING HYDRANT
N.T.S.



DRAINS IN PROXIMITY TO FOOTINGS AND FOUNDATIONS.
SHALL COMPLY WITH THE FOLLOWING

1. DRAINS SHALL PASS UNDER A STRIP OF FOOTING AT NOT LESS THAN 45° AND HAVE A MINIMUM CLEARANCE OF 25mm FROM THE TOP OF THE PIPE TO THE UNDER SIDE TO ANY FOOTING.

2. DRAIN LAID THROUGH FOOTINGS AND WALLS, OTHER THAN BELOW GROUND EXTERNAL WALLS, SHALL BE INSTALLED WITH AN ANNULAR SPACE OF NOT LESS THAN 25mm FILLED WITH A LINER OF FLEXIBLE MATERIAL.

3. WHERE A DRAIN IS TO BE LAID PARALLEL TO A FOOTING. THE EXCAVATION SHALL COMPLY WITH AS3500 CLAUSE 5.2 PART 2 AND ABOVE DETAIL.

4. DRAINS AND PIPES PASSING THROUGH WALLS AND FOOTINGS SHALL COMPLY WITH THE STRUCTURAL ENGINEERING SPECIFICATIONS FOR THE PROJECT.

DETAIL 4: PIPEWORK IN RELATION TO FOOTINGS AND FOUNDATIONS
N.T.S.

No.	Date	Details
C	7/3/25	SEWER SITE COORDINATION / GEOTECH REF
B	12/2/25	SEWER SITE COORDINATION
A	28/6/24	CONSTRUCTION / APPROVAL
P2	14/6/24	DESIGN FINALISATION
P1	8/4/24	PRELIMINARY DESIGN

Client/Architect: KOSCIUSZKO THREDBO PTY/LTD

Hydraulic Consultant: SCOTT HARRIS & ASSOCIATES p/l
- Hydraulic (plumbing) - Fire Protection - Civil (stormwater) - Building Services - - Design & Documentation - Project Management - Consultancy Services -
www.sharris.com.au
email info@sharris.com.au
ABN 73 623 920 883

Project: THREDBO VILLAGE LOTS 794 & 795
KOSCIUSZKO THREDBO P/L
WATER AND SEWER SERVICES

Drawing: HYDRAULIC SERVICES
COVER SHEET
SPECIFICATION NOTES
DETAIL SHEET 1

Project No.	2023048
Drawing No.	H0-01
Revision	C
Scale	1:150 (@ A1)
Date	8/4/24
Drawn	S.H
Sheet	1 of 4 A1
Designed	S.H. Dip Engineering Plumbing Services m.AHSCA

LOCATE EXISTING Ø150 SEWER. MAKE NEW Ø150 CONNECTION VIA MIN 45° SLOPED JUNCTION WITHIN VOID AREA AS REQUIRED. INSTALL IO WITH GAS TIGHT ACCESS FROM WITHIN VOID AREA

EXISTING Ø150 SEWER AT GRADE WITHIN SUB FLOOR VOID AREA

EXISTING RETAINING WALL / VOID AREA WALL

NOTE 1

Ø150

EXISTING RETAINING WALL / VOID AREA WALL

ESTIMATED ZONE OF INFLUENCE BOUNDARY

IL 1377.900

CO

EXISTING SEWER TO BE MADE REDUNDANT

EXISTING MANHOLE RL 1378.995 IL 1377.887

CAP-OFF EXISTING SEWER SIDE LINE (UPSTREAM OF SAHSA'S CONNECTION)

EXISTING SEWER PROVISIONS FOR SASHA'S APARTMENTS (TO REMAIN)

SQUATTERS RUN APPARTMENTS

LOT No. 792

SASHAS APARTMENTS

LOT No. 793

GGINGS TERRACE

LOT No. 736

LOT No. 722

GOLDEN EAGLE

1375.00
1376.00
1377.00
1378.00
1379.00
1381.00
1382.00
1383.00
1384.00
1385.00
1386.00
1387.00
1388.00
1389.00
1390.00
1391.00
1392.00
1393.00
1394.00
1395.00
1396.00
1397.00
1398.00
1399.00
1400.00

INSTALL NEW CLEAR OUT WITH RISER SHAFT WITH BOLTED TRAP SCREW (GAS TIGHT COVER)

LOCATE AND MAKE CONNECTION TO NEW BLACKBEAR SEWER CONNECTION SHAFT PROVISION AT IL 1380.060 (CO-ORDINATE ON SITE)

NEW BLACKBEAR RETAINING WALL

BLACKBEAR

LOT No. 794

EXTEND Ø150 SERVICES TO WITHIN SITE BOUNDARY AS REQUIRED FOR EXTENSION BY OTHERS (BLACKBEAR)

EXISTING TREE

LOCATE EXISTING SEWER PROVISIONS AND CAP OFF - REMOVE UPSTREAM DELETED SERVICE

NEW SEWER CONNECTION RISER SHAFT / JUMP UP # 3

NEW SEWER CONNECTION RISER SHAFT / JUMP UP # 2

EXISTING TREE

NEW SEWER CONNECTION RISER SHAFT / JUMP UP # 1

EXISTING CANDLELIGHT LODGE SEWER DRAINAGE PROVISION

LOCATE EXISTING SEWER DISCHARGE PROVISION FROM CANDLELIGHT LODGE AND MAKE CONNECTION TO NEW Ø150 SEWER INTO NEW SEER RISER SHAFT AT IL AS REQUIRED
ENSURE INSTALLATION OF BUILDING OVERFLOW GULLY PROTECTION AS PER AS3500.2

CANDLELIGHT

LOT No. 795

GEEBUNG SKI CLUB

LOT No. 796

Ø160 PN16 CW HDPE

MAKE NEW Ø150 TEE AND VALVE CONNECTION FROM NEW "HIGH LEVEL" Ø150 WATER MAIN EXTENSION AS REQUIRED FOR CONNECTION TO BLACKBEAR SITE FIRE SPRINKLER SERVICE WATER SUPPLY PROVISIONS (AS PER DETAIL 2 / H0-01)

INSTALL FLUSHING HYDRANT AS PER DETAIL 3 / H0-01

EX ELE -1.0
EX ELE -0.8
EX WATER-1.0
EX WATER-0.8
EX ELE -1.3
EX ELE -1.2
EX WATER-0.8
EX ELE -0.7

ACTIVE LOW LEVEL ZONE Ø150

Ø160 PN16 CW HDPE

NEW Ø160 PN16 CW HDPE (HIGHZONE)

LOCATE EXISTING LOW LEVEL DICLØ150 ACTIVE WATER MAIN, MAKE NEW Ø150 TEE AND VALVE CONNECTION AS REQUIRED FOR CONNECTION TO BLACKBEAR SITE DOMESTIC AND FIRE HYDRANT WATER SUPPLY PROVISIONS (AS PER DETAIL 2 / H0-01)

NOTE 3

NOTE 3

NOTE 2

NEW Ø160 PN16 CW HDPE (HIGHZONE)

LOCATE EXISTING DICL Ø150 HIGHZONE CW MAIN, MAKE NEW Ø150 CONNECTION AND EXTEND INSTALL WITH PATH VALVE AS (PER DETAIL 2 /H0-01)

ACTIVE HIGH LEVEL ZONE

HIGH NOON SKI CLUB

LOT No. 721

NOTES

1) RISER CLEAROUT ACCESS TO FINISHED GROUND LEVEL WITH GAS TIGHT COVER (BOLTED TRAP SCREW)
2) REFER TO LONG SECTION DRAWING H1-03 FOR DETAILED LEVEL AND PIPING INFORMATION
3) ASSUMED LOCATION OF EXISTING ELECTRICAL SERVICES TO BE CONFIRMED ON SITE WITH LIVE LOCATES INFORMATION

No.	Date	Details
E	7/3/25	SITE CO-ORDINATION SEWER
D	12/2/25	SITE CO-ORDINATION SEWER
C	4/20/25	REVISED SEWER CONECTION POINT
B	8/7/24	CONSTRUCTION / APPROVAL
A	28/06/24	CONSTRUCTION / APPROVAL
P2	14/6/24	DESIGN FINALISATION
P1	8/4/24	PRELIMINARY DESIGN

Client/Architect: KOSCIUSZKO THREDBO PTY/LTD

Hydraulic Consultant: SCOTT HARRIS & ASSOCIATES p/l
- Hydraulic (plumbing) - Fire Protection - Civil (stormwater) - Building Services - - Design & Documentation - Project Management - Consultancy Services -
www.sharris.com.au
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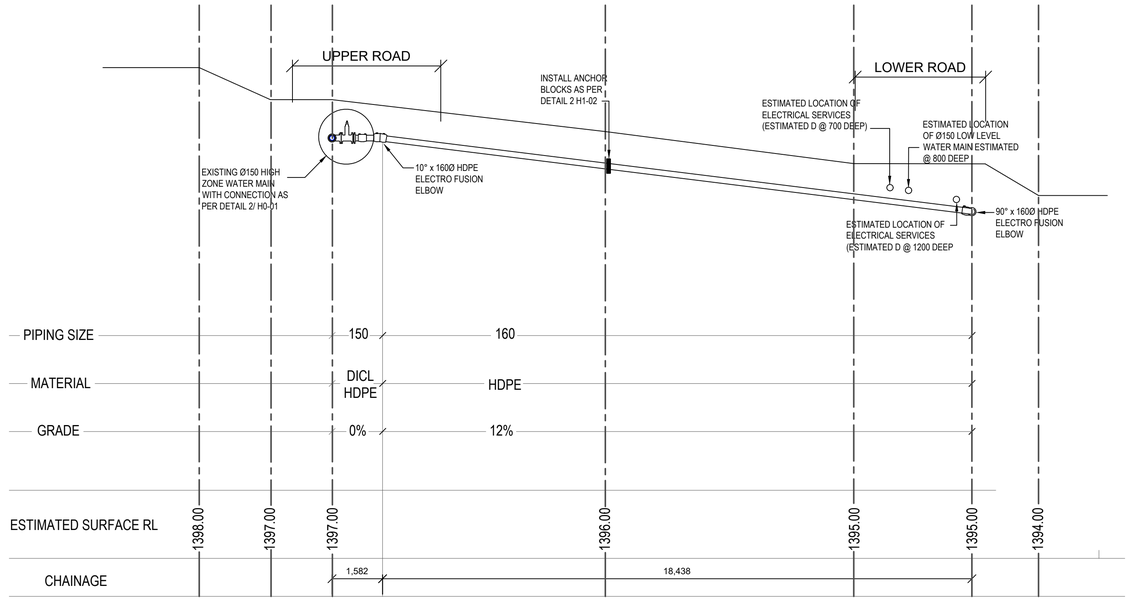
Project: THREDBO VILLAGE LOTS 794 & 795
KOSCIUSZKO THREDBO P/L
WATER AND SEWER SERVICES

Drawing: HYDRAULIC SERVICES
SERVICES LOCATION
LAYOUT PLAN

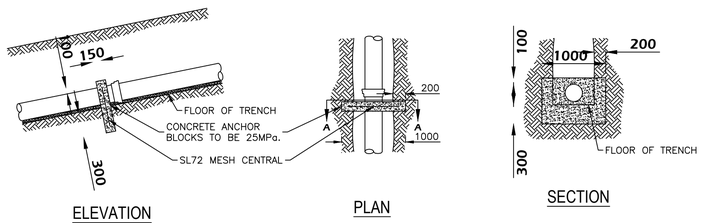
Project No.	Drawing No.	Revision
2023048	H1-01	E

Scale 1:150 (@ A1) | Date 8/4/24
Drawn S.H | Sheet 2 of 4 | A1
Designed S.H. Dip Engineering Plumbing Services m.AHSCA



DETAIL 1- SECTION A-A (STEEP WATER MAIN SECTION)

NTS.



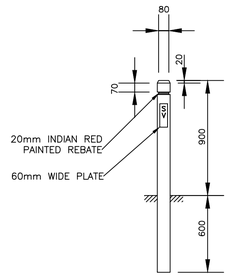
ELEVATION PLAN SECTION

DETAIL 2 - ANCHOR BLOCK DETAIL (SEWER)

N.T.S

INDICATORS - GENERAL NOTES

1. INDICATOR POSTS SHALL CONSIST OF 100 x 100 RHS PRECAST CONCRETE, REDGUM TIMBER OR PLASTIC.
2. STEEL POSTS AND RED GUM POSTS SHALL BE PAINTED AS FOLLOWS:
   - ONE (1) COAT OF APPROVED PRIMER.
   - TWO(2) COATS OF APPROVED EXTERIOR WHITE PAINT ON ALL SIDES FROM GROUND LEVEL TO THE TOP.
3. CONCRETE POSTS SHALL BE PAINTED WITH TWO(2) COATS OF APPROVED PLASTIC EXTERIOR WHITE PAINT ON ALL SIDES FROM GROUND LEVEL TO THE TOP.
4. ALL LETTERS AND NUMERALS AND THE TOP OF THE POST SHALL BE PAINTED BLACK. PAINTING SHALL BE TWO (2) APPLICATIONS OF APPROVED EXTERIOR ENAMEL.
5. ALL LETTERS AND NUMERALS SHALL BE 50 HIGH FIGURES APPLIED TO THE INDICATOR BY MEANS OF STENCILS. MINIMUM SPACE SHALL BE 10. MINIMUM THICKNESS OF STROKES SHALL BE 5.
6. INDICATOR POSTS SHALL BE LOCATED AGAINST THE BUILDING LINE IN ROAD RESERVES AGAINST EXISTING FENCES ADJACENT TO THE PIPELINE OR IN OPEN COUNTRY SET AT A CONSTANT OFFSET OF 1500 FROM THE CENTRELINE OR AS DIRECTED BY THE ENGINEER.



SV – 40mm HIGH LETTERS

ANTI–CLOCKWISE CLOSING – 10mm HIGH LETTERS

DETAIL 3- VALVE INDICATOR POST DETAIL

N.T.S

No.	Date	Details
B	9/7/24	CONSTRUCTION / APPROVAL
A	28/06/24	CONSTRUCTION / APPROVAL
P1	14/6/24	PRELIMINARY DESIGN

Client/Architect: KOSCIUSZKO THREDBO PTY/LTD

Hydraulic Consultant: SCOTT HARRIS & ASSOCIATES p/l
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Project: THREDBO VILLAGE LOTS 794 & 795
KOSCIUSZKO THREDBO P/L
WATER AND SEWER SERVICES

Drawing: HYDRAULIC SERVICES
SERVICES LOCATION
DETAIL SHEET 2

Project No.	Drawing No.	Revision
2023048	H1-02	B

Scale	N.T.S	Date	8/4/24
Drawn	S.H	Sheet	3 of 4 A1
Designed	S.H. Dip Engineering Plumbing Services m.AHSCA		

ATTENTION: THIS DRAWING HAS BEEN PRODUCED FOR THE PURPOSE OF INDICATING THE DIAGRAMMATIC DESIGN INTENT AND SCOPE OF WORKS REQUIRED FOR THE INSTALLATION OF SERVICES AS DETAILED AND SHOULD NOT BE INTERPRETED AS BEING FINAL. THIS DOCUMENT SHOULD BE READ IN CONJUNCTION WITH THE ARCHITECTURAL DRAWINGS, ASSOCIATED SPECIFICATIONS CODES AND STANDARDS. ALL LEVELS AND EXISTING SERVICES SHALL BE INVESTIGATED AND CONFIRMED ON SITE BY THE SUBCONTRACTOR AND/OR BUILDER PRIOR TO THE COMMENCEMENT OF ANY WORKS. THIS DOCUMENT IS SUBJECT TO COPYRIGHT AND IS NOT TO BE REPRODUCED WITHOUT THE CONSENT OF SCOTT HARRIS & ASSOCIATES. PH 0411 512 887

	I–H	H–G	G–F	F–E	E–D	D–C	C–B	B–A
PIPING SIZE	Ø150	Ø150	Ø150	Ø150	Ø150	Ø150	Ø150	Ø150
MATERIAL	UPVC	UPVC	UPVC	UPVC	UPVC	UPVC	UPVC	UPVC
GRADE	ESTIMATED 7% (ADJUST TO SUITE CONNECTION ON SITE)	7%	7%	7%	7%	3.75%	3.75%	4.5%
CHAINAGE	2,700	2,120	21,060	12,760	3,830	2,150	2,497	2,668

	I	H	G	F	E	D	C	B	A
ESTIMATED EXISTING SURFACE RL	1378.599	1379.560	1379.560	1380.588	1381.496	1383	1384	1384.924	1386.227
ESTIMATED NEW SURFACE RL (BLACKBEAR WORKS)	N/A	N/A	N/A	1380	1380.935	1382.397	1383.318	N/A	N/A
ESTIMATED IL	1377.339	1377.800	1377.950	1379.520	1380.410	1380.682 1381.830	1381.910 1382.715	1382.808 1384.105	1384.225

DETAIL 2- SEWER DRAINAGE LONG SECTION

1:100

No.	Date	Details
A	7/3/24	SITE CO-ORDINATION SEWER
P1	12/02/25	FOR APPROVAL

Client/Architect: KOSCIUSZKO THREDBO PTY/LTD

Hydraulic Consultant: SCOTT HARRIS & ASSOCIATES p/l
- Hydraulic (plumbing) - Fire Protection - Civil (stormwater) - Building Services -
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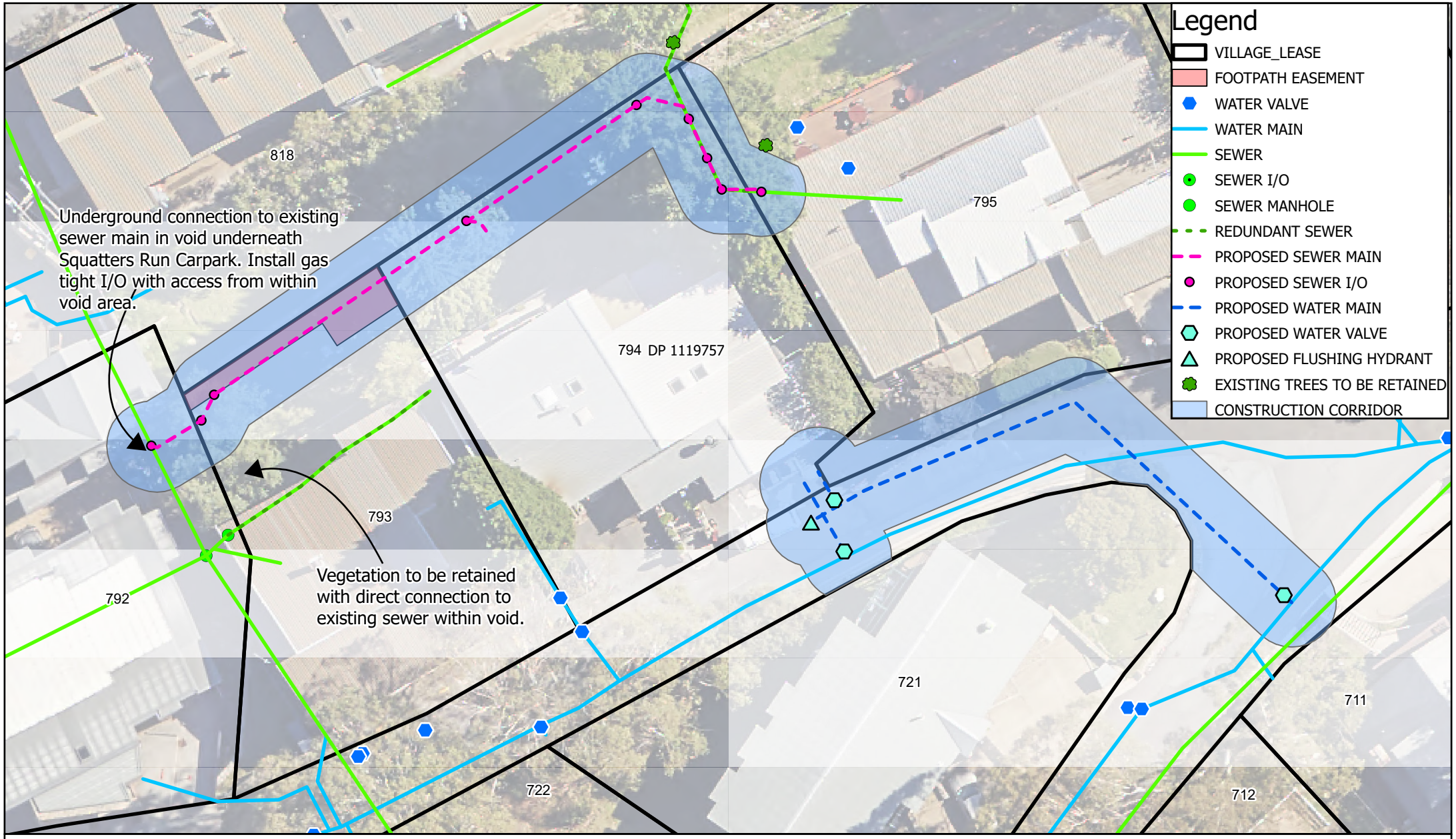
Project: THREDBO VILLAGE LOTS 794 & 795 KOSCIUSZKO THREDBO P/L WATER AND SEWER SERVICES

Drawing: HYDRAULIC SERVICES SERVICES LOCATION DETAIL SHEET 3 SEWER LONG SECTION

Project No. 2023048 | Drawing No. H1-03 | Revision A

Scale N.T.S | Date 8/4/24
Drawn S.H | Sheet 4 of 4 | A1
Designed S.H. Dip Engineering Plumbing Services m.AHSCA



Scale: 1:339

0 2.5 5 10 15 20 Meters

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 2020
Grid: GDA 2020 MGA Zone 55

N

THREDBO

SITE PLAN

Project: GIS2418 - Blackbear Sewer & Water Supply Upgrades

Revision: H

Date: 07/03/2025

Produced By: KOS

Form 4 – Minimal Impact Certification

DA Number: _____

This form may be used where minor construction works which present minimal or no geotechnical impact on the site or related land are proposed to be erected within the "G" line area of the geotechnical maps.

A geotechnical engineer or engineering geologist must inspect the site and/or review the proposed development documentation to determine if the proposed development requires a geotechnical report to be prepared to accompany the development application. Where the geotechnical engineer determines that such a report is not required then they must complete this form and attach design recommendations where required. A copy of Form 4 with design recommendation, if required, must be submitted with the development application.

Please contact the Alpine Resorts Team in Jindabyne for further information - phone 02 6456 1733.

To complete this form, please place a cross in the appropriate boxes ☐ and complete all sections.

1. Declaration made by geotechnical engineer or engineering geologist in relation to a nil or minimal geotechnical impact assessment and site classification

I,

Mr ☒ Ms ☐ Mrs ☐ Dr ☐ Other ☐

First Name	Family Name
Mark	Bartel

OF

Company/organisation

Asset Geotechnical Engineering Pty Ltd (trading as AssetGeoEnviro)

certify that I am a geotechnical engineer /engineering geologist as defined by the "Policy" and I have inspected the site and reviewed the proposed development known as

Proposed Water and Sewer Installation, Lots 793-795, Diggins Terrace, Thredbo Village NSW

As a result of my site inspection and review of the following documentation

(List of documentation reviewed)

Hydraulic Services Plans (by Scott Harris & Associates Pty Ltd, ref 2023048, drawings H0-01(C) 7/3/25,

H1-01(E) 7/3/25, H1-02(B) 9/7/24, H1-03(A) 7/3/24).

Site Plan (by Thredbo Pty Ltd, project GIS 2418, revision H, 7/3/25).

I have determined that;

- ☒ the current load-bearing capacity of the existing building will not be exceeded or adversely impacted by the proposed development, and
- ☒ the proposed works are of such a minor nature that the requirement for geotechnical advice in the form of a geotechnical report, prepared in accordance with the "Policy", is considered unnecessary for the adequate and safe design of the structural elements to be incorporated into the new works, and
- ☒ in accordance with AS 2870.1 Residential Slabs and Footings, the site is to be classified as a type

(insert classification type)

Class P

- ☒ I have attached design recommendations to be incorporated in the structural design in accordance with this site classification.

I am aware that this declaration shall be used by the Department as an essential component in granting development consent for a structure to be erected within the "G" line area (as identified on the geotechnical maps) of Kosciuszko Alpine Resorts without requiring the submission of a geotechnical report in support of the development application.

2. Signatures

Signature

Mark Bartel

Chartered professional status

CPEng 35641 NER (Civil)

Name

Mark Bartel

Date

8 March 2025

3. Contact details

Alpine Resorts Team
Shop 5A, 19 Snowy River Avenue
P O Box 36, JINDABYNE NSW 2627
Telephone: 02 6456 1733
Facsimile: 02 6456 1736
Email: alpineresorts@planning.nsw.gov.au