BEFORE THE COMMISSIONERS
APPOINTED BY THE DUNEDIN CITY COUNCIL

IN THE MATTER	of the Resource Management Act 1991 (the **Act**)
AND	Variation 2 to the Dunedin City Council Second Generation District Plan (**Variation 2**)
BETWEEN	**GTJM PROPERTY LIMITED**
	Submitter (OS263)
AND	**DUNEDIN CITY COUNCIL**
	Territorial Authority

BRIEF OF EVIDENCE OF JAMES MOLLOY

DATED 5 AUGUST 2022

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BREIF OF EVIDENCE OF JAMES MOLLOY

INTRODUCTION

1. My name is James Molloy. I am a geotechnical engineer and the principal of Terra Managed Design and Construction (Terra MDC Ltd), a civils and geotechnical engineering consultancy firm based in Dunedin.

2. I hold a Batchelor of Civil Engineering (1992) from Canterbury University and am a Chartered Professional Engineer[1]. I am based in Dunedin and work locally and across the lower South Island on a on a diverse range of projects within residential, water storage and irrigation infrastructure and commercial developments through into roading infrastructure and complex pipeline projects.

3. As part of these projects I undertake geotechnical investigation through to ground interpretation and the integration of supporting engineering reports and design for each project. This interpretation and design integration then translates into the design of earthworks, drainage, engineered slopes, retaining walls, soils or rock stabilisation and foundations. I currently work for a variety of clients, these ranging from local authorities, private individuals, various contractors and consultants across the lower South Island of NZ.

4. I have gained extensive experience from over 25 years' of working for a variety of consultant and contractors in civil engineering and specialist geotechnical fields in the UK and Ireland (initial fifteen years) and then latterly within New Zealand and Australia.

5. I am also expanding from consultancy, looking to engage in the mentoring and tutoring within the wider geotechnical industry. I have tutored over four years for NZIHT (2018-2021) on their geotechnical coursework for the Civil Engineering diploma. I am currently mentoring several young engineers and graduate hydrologist in their growth and learning of engineering.

6. I have been engaged as an 'Expert Witness' to review a number of projects for purposes of insurance assessments, or where the geotechnical design and/or construction has failed. As part of that role I have also presented in both district court and in formal mediation meetings.

7. I was commissioned by GTJM Property Limited to provide initial geotechnical advice regarding the site at 336 Portobello Road, "Preliminary Geotechnical Assessment of

[1] Attached at Appendix 1 is my CV providing further details on my experience.

Land for the Proposed Subdivision at 336 Portobello Rd, Dunedin" dated 30 June 2021. That document is attached at Appendix 2.

8. I have also been asked to provide this evidence responding to geotechnical matters raised in the section 42A report, supporting evidence and concerns raised in submissions. My responses in relation to these matters are set out in the letter dated 5 August 2022 ' Review of the Preliminary Dengineering Designs for the Proposed Subdivision at 336 and 336A Portobello Road, Dunedin which is attached at Appendix 3

CODE OF CONDUCT

9. I confirm I have read the 'Code of Conduct for Expert Witnesses' contained in the Environment Court Practice Note (2014). I have complied with this Code of Conduct in the preparation of this evidence, and will follow the Code when presenting this evidence. Unless I state otherwise, I confirm the matters addressed in this written statement of evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express. I have outlined all data, information, facts, and assumptions made in forming my opinions.

SCOPE OF EVIDENCE

10. This evidence addresses the following:

    (a) Summary of the site characteristics and conclusion on whether area to be rezoned is appropriate from a geotechnical point of view

    (b) How any geotechnical matters can be addressed through subsequent consent processes;

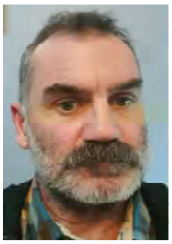
    (c) Responding to matters in the section 42A report;

    (d) Responding to matters raised in submissions.

APPENDIX 1
JAMES MOLLOY CV

James Molloy

Principal Geotechnical & Civil Engineer



NAME: JAMES W H MOLLOY

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QUALIFICATIONS

- Civil Engineering Intermediate - University of Otago, New Zealand 1989,
- John Dennistoun Scholarship - New Zealand 1989
- B.E. Civil - University of Canterbury, New Zealand 1990-1992
- Chartered Member of Engineering 2014 (member since 1992)
- Ordinary Member of the Institute of Engineers of Ireland 1998
- Member of the British Tunnelling Society & Geotechnical Society London, U.K. 1997
- NZ Geotechnical Society and NZSoLD 2010
- NZ Society of Earthquake Engineering 2010

SPECIALISATION

- Geotechnical investigations and designs of piling, grouting, earthworks, ground stabilisation and mining remediation, soils and rock slope design, temporary ground-works, contract documentation
- Contract management, programming, procurement and supervision of heavy civils works for commercial and industrial site developments, irrigation and hydro projects and roading or railway infrastructure.

PAPERS

- “Permeation Grouting in Kelvin Valley Sewer Tunnel - Grout Stabilisation of Collapsed Alluvial -Glacial moraines” Fifth YGE Conference (BGS) 1998.
- “Christchurch Earthquake and the Emergency Response – Rockfall Remediation in the Port Hills” GHD Internal Staff Conference 2011
- Noted as contributor in various papers presented by GNS on the 2011 Christchurch Earthquakes.
- ‘Millerton Rock Cutting Remediation in Westport’ November 2013 -NZGS Symposium

OTHER SKILLS

- Microsoft general suite of software, programme management software Project, @ RISK, AutoCAD, 3D terrain modelling, Holebase, SlopeW, Oasys Piling software, RocScience geo-software.
- Teaching Geotechnical engineering for NZIHT – Civil Engineering Diploma course, 2018 - 2021
- NZS3910, ICE and NEC Condition of Contract, various New Zealand, European, British and American Standards and Specifications.
- Rail working environment trained and certified (UK)
- Civils Work / Site Safety certified – Civil Engineering Designer and Project Site Manager (UK)
- First Aider at Work since 1992
- Full car / motorbike licence with specialist 4WD and urban driving training.

EXPERIENCE

I am a civils and geotechnical engineer, based in Dunedin since April 2010 initially working for GHD, and then establishing a sole trading geotechnical and civils consultancy in 2013 ‘Terra MDC Ltd’. I work on a diverse range of projects within residential, water storage and irrigation infrastructure and commercial developments through into roading infrastructure and hydro projects. I currently work for a variety of clients, these ranging from local authorities, private individuals, various contractors and consultants across the lower South Island of NZ.

I have gained extensive experience from over 25 years’ of working for a variety of consultant and contractors in civil engineering and specialist geotechnical fields in the UK and Ireland (initial fifteen years) and then latterly within New Zealand and Australia. The project works ranging from geotechnical interpretation and review of reports, design of soil/rock stabilisation and site supervision and management of major lineal infrastructure projects experience in complex heavy civil engineering and specialist geotechnical fields of ground improvement.

I am also expanding from consultancy, looking to engage in mentoring and tutoring within the wider geotechnical industry. Currently I am teaching for NZIHT on their geotechnical coursework for the Civil Engineering diploma. I am currently mentoring a number of young engineers in their growth and learning of geotechnical engineering.

I have been engaged as an ‘Expert Witness’ to review a number of projects where the geotechnical design and/or construction has failed. As part of that I have also presented in both district or high court and mediation meetings.

I was heavily engaged over 2010 to 2013 in tendering and programming works across New Zealand for

GHD, plus taking on a more challenging technical lead role in the Geotechnical group along with aiding and guiding the recruitment, growth and workload balancing of their Geotechnical team. I had spent most of 2011 and 2012 working in the Christchurch earthquake recovery working within the Civil Defence geotechnical advisory group and latterly CCC's Port Hills Geotech Group. Over that period I had also maintained and developed GHD's project workload in the irrigation industry and continued bridge replacements across the South Island, plus aided in the remedial design of soils slippage emergency works in the north island.

My experience, comprising geotechnical and civil engineering design, along with my well-developed abilities learned from integrating into many multi discipline project teams, lets me utilise a high level of project management skills and leadership in the planning, supervision and management of complex geotechnical and civil engineering projects.

WORK HISTORY:

March 2013+	Terra MDC Ltd – Dunedin NZ, Civils & Geotechnical design / project management consultancy.
2010 – 2013	GHD Limited – Dunedin NZ, Principal Geotechnical Engineer.
2001 – 2010	Molloy Geotechnics Limited – Scotland, England and Ireland as freelance Senior Geotechnical Engineer or Construction Agent / Project Manager.
1998 – 2001	WS Atkins – Ireland, Senior Geotechnical Engineer and Major Projects Manager.
1996 – 1998	WA Fairhurst and Partners – Scotland, Geotechnical Engineer.
1994 – 1996	Cementation Piling – Scotland, Geotechnical Project Engineer.
1990 – 1994	Contract Engineer – various contract roles in NZ, USA and England.

The scope of work and my involvement in projects ranges from;

- Conceptualisation through to detailed design, specification, procurement and construction supervision / management of drill and grouting works, earthworks and heavy civils for new or realigned motorways and trunk roads, railway lines, irrigation and hydro dams, mineral, commercial and residential developments.
- Supervision and managements of rock stabilisation and slope restoration works, design of temporary works in high rock cuttings for highways, railways and urban development.
- Assessment and design and management of earthworks for remedial, maintenance or refurbishment of cuttings and embankments in railways, roading, mining and dams.
- Management and planning of the interaction of geotechnical and civils activities with other engineering disciplines e.g. environmental, mining, structures or tunnelling.
- Design of piled load transfer platforms and foundations (geogrid / concrete slab solutions on piled, vibro compaction and replacement, grouting ground improvement and gravity bearing structures) assessment, design and construction for wind farms, retaining walls, roads, railway and structures.
- Design and project management of over-water and land based site investigations for various infrastructure and development projects.
- Design and project management of grout consolidation of mine-workings within live and non-operational railways, residential, commercial developments and new or existing road schemes.

RECENT NEW ZEALAND PROJECTS:

- Investigation and geotechnical design of 35 homogeneous small and zoned 'Large' (6.0m to 15m) Irrigation Dams across Central Otago, North Otago and South Canterbury, including for PIC assessments, preparing dam operation and maintenance manuals and ongoing safety inspections.
- Managed 50+ investigation and geotechnical designs for retaining walls and reforming roads formed across or upon various landslides in the Dunedin City and Waitaki District roading network.
- Investigation and geotechnical design of deep shaft dewatering.
- Emergency assessments of numerous land slippages including remedial design for WDC Roads, DCC Roads and Parks after the May 2010, June 2015 and July 2017 Flood Events. Undertook the geotechnical design and project management of over 35 projects in 2017-2018.
- Expert witness for failed agricultural structures, rock-fall and landslide risk for residential development in lower South Island,
- Site assessment and earthworks or piled design for new residential developments in Christchurch, Timaru, Dunedin and Oamaru on liquefiable soils conditions, steeply sloped or non-engineered fill sites.

APPENDIX 2
GEOTECHNICAL ASSESSMENT REPORT

30 June 2021
Terra MDC Limited
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E-mail: james.molloy@terramdc.co.nz
Web: www.TerraMDC.co.nz

For attention: Chris Adams
For GTJM Property
(by email only)

Project Reference: 202106304

Dear, Chris

RE: Preliminary Geotechnical Assessment of Land for the Proposed Subdivision at 336 Portobello Rd, Dunedin

This report has been prepared as a preliminary geotechnical assessment, providing a summary of the likely ground conditions and land hazards along with identifying the likely design and construction issues in subdividing and developing the above site. It is understood the intention is to subdivide the north end of the property into 12 Lots with a proposed new road alignment from Portobello Rd along the northern boundary. A concept subdivision layout plan has been provided by Terramark (Ref: 12178 attached).

The data provided and the findings of this report are based upon a site walkover and shallow ground investigation completed on 21st of June 2021 by Terra MDC. Reference is also made to the databases from Otago Regional Council (ORC) for hazards and Dunedin City Council (DCC) for land information and the Geological and Nuclear Sciences (GNS) for information on geology and active faults in the region.

The ground investigation, comprising three Scala Penetrometers (SP01 – SP03), and ten machine excavated test pits (TP01 – TP10) were undertaken. The investigation information along with a number of photos taken during the site visit are attached for your reference. It is considered that the preliminary ground investigation and design assumptions will require to be verified, possibly with additional specific ground investigation, by a suitably qualified engineer during the detailed design for the new access and subdivision development and then during the construction phase to confirm the observations and recommendations made in this initial assessment.

Observations around the Property and Immediate Environs:

The proposed subdivision has a total area of 1.5737 ha and is zoned as *Township and Settlement* [1]. The subdivision is bounded by developed residential properties to the north, east and west boundaries and by the remaining area of the existing property to the south which is zoned as *Rural Residential* 2. There is a DCC – 'Significant Natural Landscape Overlay' situated over the southern area of the existing property which encroaches the southern boundary of the proposed subdivision. The site is currently used as farmland for grazing stock with some tree clearance under way on the lower flanking slopes.

The site is currently accessed via a narrow driveway from Portobello Rd in the northwest corner of the site. It is noted the driveway entrance lies within DCC road reserve. The driveway has an asphalt surface up to the neighbouring property of 335 Portobello Rd. There is a 2.0m to 2.5m high steeply hand stacked rock faced wall supporting a section of the slope above the driveway in this area. The driveway is then gravel surfaced which runs into an unsurfaced farm track midway along the northern boundary. There are two farm tracks diverting from the driveway midway along the northern boundary which provides access to the southwest area and the existing house

[1] DCC District Plan Map: *http://apps.dunedin.govt.nz/WebMaps/RatesMap/*

situated in the centre of the site. There are boundary fences running along the north and east boundaries as well as several farm fences running through the site.

The site is situated on a northerly facing hill slope with an approximate gradient of 15° to 20°. Steeper sections of 20° to 25° slopes and locally up to 40° are found along the driveway alignment and where farm tracks and the existing house platform have been cut into the slope. There are also incised steeper slopes running into northerly flowing gullies outside the east and west boundaries of the site.

The terrain is typically covered in thick grass with occasional areas of small bushes. There are several large trees surrounding the existing house and running along the northeast farm track. There are also a number of large tree stumps bellow the existing house area and further up the northeast farm track.

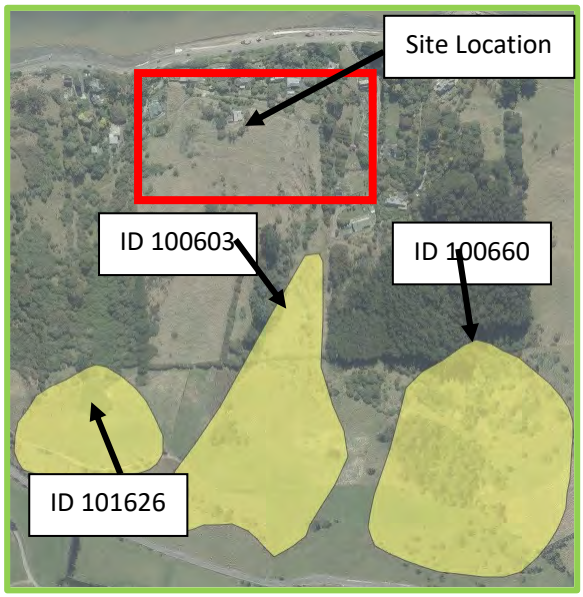
There are private watermain pipes running down the slope through the centre of the property. There are overhead powerlines and power poles running through the site between the east and west boundaries. It is unknown where the existing underground wastewater and stormwater pipes run from the existing house. There are no further reported underground or overhead services within the vicinity of the site.

Review of Geological Hazards and Other Information:

The underlying bedrock geology of the site is noted to be in the Dunedin Volcanics Group [2] formed during the second main eruptive phase. The bedrock is described as extensive flows of trachybasalt, basalt, phonolite, and dolerite comprising olivine minerals. The underlying geology is anticipated to be overlain by a mantle of loess typically c.1.0m and to 3.0m thick.

The ORC Hazards database notes there to be an active debris-dominated alluvial fan hazard which runs from the western gully and encompasses the western and northern area of the site. A debris-dominated alluvial fan is determined where narrow and steep gullies are choked by landslide debris causing widespread sediment deposition and potential flooding. These events are only likely to occur during heavy and prolonged rain events. It is considered that a significant land slippage during a flood event within the gully would need to occur to cause alluvial debris deposition within the site, albeit long term erosion on bare soils may occur ass minor sediment discharges over time.

There are three mapped landslide hazards approximately 100m and 300m south or upslope of the site. The mapped landslide areas are situated at the head of the gullies and partway along the slopes which flank the east and west sides of the site. The areas are defined by the topographical features such as very steep gully slopes which are likely the result of landslide activity. The landslide movement is assumed to be complex with a medium sensitivity and the initiation of the slide likely to be prehistoric.



There is no recent information or monitoring undertaking of the landslide areas with no reported damages to the below residential properties at Portobello Rd. It is considered the centre of the site is a sufficient distance away from the flanking gullies where it will not be affected by movement within the mapped landslide areas. The east and west sides of the site, where situated on the steeper >20 degree gully slopes are considered to be at a possible risk of the mapped landslide areas.

Figure 1: Proximity of the site to the mapped historical Landslide Hazards.

[2] GNS Geology Webmaps: http://data.gns.cri.nz/geology/

The ORC Hazards database [3] notes that the site lies on an area with low to nil susceptibility to liquefaction during seismic shaking with intensity comparable to that of a 1:100year earthquake. The site is categorised as Domain 'A', which is described as ground underlain by rock or firm sediments.

The nearest active fault to the site is the Titri Fault which is approximately 14 Km west of the site. The site lies within an area where seismic shaking [4] from an Alpine Fault Magnitude 8.0 (1:100 year) event can expect damage representative of Modified Mercalli Intensity (MMI) of 5. The requirements of NZSL 1170 'Structural Design Actions' would prevail in any structural design. The site lies in what is determined as being Class 'B', 'shallow rock' per NZS:1170-Part 5.

Geotechnical Investigation:

The site investigation was carried out along the proposed road alignment, and within several of the proposed Lots. The test pits were backfilled with the arisings and lightly compacted. Where the test pits are encountered in future earthworks or foundations they will require to be excavated and backfilled with engineering fills or mass concrete.

The test pit and Scala Penetrometer results determined the ground conditions to be typically four soil types;

- Topsoil, comprising a dark brown silt with occasional roots.
- Fills, comprising mottled dark brown clayey silt with some gravels and cobbles.
- Loess, comprising a mottled grey and orange brown silty clay.
- Weathered volcanic's, comprising dark brown and grey clayey silt. (Tuff)

Topsoil was encountered throughout the site typically as a 0.25m to 0.3m thick layer. Thin layers of topsoil are anticipated to be overlying areas of fill which would overlie the original topsoil.

Fills were encountered at 0.3m to 0.7m depth in the lower northwest area of the site and 0.4m depth below the existing house building platform, which will also have thicker layers of fills used to form the outer slopes of the platform. The fills comprised of what appeared to be locally excavated soil with minor gravel and cobbles throughout. All fills are noted to be soft and are overlying the original topsoil.

The natural ground was encountered as a loessial soil throughout the site. The loess was typically encountered with an upper stratum which was soft with moderate to high plasticity and in a damp condition. Infilled cracks were also recorded within the upper stratum of loess in several test pits. The Scala Penetrometer testing determined the loess to have a firm becoming stiff stratum at >0.9m below ground level. Loess is known to be an erodible soil which may also undergo 'tunnel gullying' or subsurface erosion.

The volcanic bedrock geology was encountered as a weathered tuff at 0.9m to 1.6m below ground level. The weathered tuff was typically stiff to hard and in a dry condition.

Groundwater was encountered as a slow and steady seepage at TP02 and a slight seepage at TP06. However, a persistent groundwater table was not encountered in the test pits and deeper borehole investigations would be required to determine this or as a shallow perched water-table found in the loess and volcanic soil horizon.

Geotechnical Assessment:

An initial geotechnical assessment has been undertaken to provide general advice on the driveway access, now Lots, earthworks fill and potential site issues and geological hazards. Reference is made to the proposed subdivision plan provided by Terramark. It is considered in general that the site will be suitable for the proposed sub-division with appropriate engineering and detailing to fully support this development, with further specific investigation undertaken as the design progresses from concept into detailed design.

The proposed road access will require earthworks comprising excavation and engineering filling to form a suitable road gradient and width. Retention will likely be required in several upslope locations of the road as well

[3] ORC Web-Hazard Maps http://hazards.orc.govt.nz/IntraMaps80

[4] Opus – Seismic Risk in Otago Region, May 2005

replacement of the existing stacked rock retaining wall in the northwest area of the site. The current access within the DCC Road Reserve area is a narrow roadway with a number of old retaining walls and over steep slopes, so consideration should be given to improving this to a more modern and reliable accessway, including developing appropriate sight distances for approaching and departing traffic off Portobello Road.

The proposed Lots will also require excavation and levelling off for the ground to form suitable building platforms and driveways. The subsequent development of each individual Lot for housing will require further investigation and design inputs on a case by case basis. The earthworks and building works will require to be constructed and certified to meet the various specific criteria with the following specification.

- NZS4431-1989: Code of Practice for Earth fill for Residential Development.
- NZS4404-2010: Land Development and Subdivision Engineering.
- NZS3604-2013: Timber Framed Structures
- Dunedin City Council requirements
- The developer's specific engineering specification and drawings.

Suitability of Soils for the Proposed Access Road, Foundations and Retaining Walls:

The site is situated on a steep slope which has had shallow earthworks undertaken to form the existing farm tracks and house platform. The existing earthworks are likely formed from localised cut to fill which has been pushed over the original ground with no engineering compaction. Further filling has been identified within the lower northwest area and is considered that shallow fills may present throughout the lower area of the site. These are not considered suitable for supporting future driveways or building platform and with require to be re-engineered or new fills utilised to replace those unsuitable fills which are removed.

All earthworks fill required for the proposed access road and potential building platforms shall be constructed using engineering fills comprising of site won cohesive soil or an imported granular fill. All fills will require their engineering characteristics to be defined depending on source and type of fill along with proposed end use. The earthworks and building works will require to be constructed and certified.

The topsoil and any existing fill is not considered suitable to supporting house foundations or driveways or for reuse other than as landscaping spoils or topsoil for site cover. Therefore, these soft soils shall be removed from beneath any subgrades, foundations and where any engineering fills are to be placed. The existing farm tracks are not considered suitable for directly constructing paved driveways upon due to their current state. The unconsolidated fills are unsuitable to supporting trafficking loads and will require to be removed and replaced with granular engineering fills and then surfaced with suitable pavement layers.

The loessial soils have a soft upper stratum which has an appearance of being historically disturbed or poorly consolidated. The upper stratum is noted to have a moderate to high plasticity and may potentially be an expansive soil. This means the soil is susceptible to volume change with variable moisture condition, i.e. shrinking and swelling. The soils will shrink over dryer periods which will cause cracks to form up to the surface and cause voids and settlement of foundations.

The natural soils are considered suited for supporting foundations of residential buildings where a firm to stiff strata is encountered, this is typically encountered at >0.9m below existing ground level. This would be determined as having an allowable bearing pressure Q_a >100kPa for house foundation and is defined as 'Good Ground' in accordance with NZS3604:2011 *'Timber Framed Buildings'*. The assumption is based upon foundations being those typically suitable for one or two storey residential buildings, using either shallow piled, reinforced concrete strip, or rafted slab foundations, all designed as per NZS3604. A site-specific investigation to verify the minimum depth of foundations will be required once final house locations are determined and a detailed design is available for each individual property (Lot).

The soft loess is a difficult soil to reuse as engineering fill unless carefully controlled during construction. Notably where it is used as an engineering fill and these are compacted in an over dry state, the fill is likely to have a high air voids content. Whilst the fill may appear compacted the fill is vulnerable to wetting and subsequent collapse. These issues can lead to construction and long-term performance problems with any engineering fill.

It may be worthwhile considering the introduction of an imported low quality granular fill and mixing this with the site won soils to produce a more homogeneous and denser cohesive type fill. Alternatively, the soils may be cement or lime modified to produce a more consistent soil strength and stiffness for driveway sub-grades. This soils mixing may also be undertaken insitu on the shallow transition zones in order to provide a reliable sub-grade for the access which would be a benefit by reducing the necessary thicknesses of the underlying capping and pavement layers.

Shallow cut to fill transitions are also vulnerable to moisture changes and consolidation due to trafficking and repeated drying and wetting cycles. These should have deeper transition layers built in to provide a reliable uniform foundation thickness beneath any road or building foundations.

It is anticipated that all soft spots would be determined by visual inspection, insitu testing and proof rolling. Soft spots will be rectified by removal and replaced with suitably selected and compacted engineering fill. Any soft spoils from the development excavations could be used elsewhere as landscape fills.

All earthwork fills shall be benched in where natural side slopes are steeper than 1V:5H. It is recommended that all permanent cut or filled slopes formed in clayey or poor quality granular engineering fills are constructed no steeper than 1V:2.75H (<20^{o}). Steeper filled slopes may be formed from higher quality granular engineering fills such as hard durable crushed quarry fills, and these would be assessed based upon their merits, size of slopes and type of aggregates Landscape slopes shall be formed no steeper than 1V:3H. All exposed batters and landscape fill areas will require to be covered with a minimum 0.15m thick layer of topsoil and grass seeded for erosion protection.

It is recommended any new retaining walls are designed as gabions, timber pole or timber crib retaining wall. The retaining wall foundations will require to be embedded into or founded upon 'Good Ground'. Retaining walls shall be constructed with appropriate back of wall drainage and backfilled with imported granular engineering fill. All retaining walls >1.5m high or surcharged by slopes and driveway loads shall be designed and certified by a suitably qualified engineer with slope stability analysis undertaken too.

When a final access road and Lot layout design, including the earthworks, has been completed it is recommended bulk soil samples are recovered from the site and undergo laboratory testing for determining it characteristics as an engineered fill. The tests will determine the maximum dry density (MDD) and optimum moisture content (OMC) relationship plus soils plasticity plus the natural and remoulded shear strength.

The engineering fills will typically require to be compacted to >95% of the MDD with the moisture content typically within the range of -2% and +1% of the OMC. Moisture conditioning may be necessary, and it would be prudent to check for shear strength in early earthworks trials too. It is recommended that the compaction achieves <10% air voids to prevent vulnerability to moisture induced settlement. Specific enhanced compaction criteria may be required for building foundations. All engineering fill >0.5m thickness shall be monitored and certified by a suitably qualified engineer.

It is considered that the initial ground investigation and design assumptions will require to be verified by further specific investigation for final access road earthworks and retaining wall designs to confirm the above prior to submitting any resource or building consent applications.

Groundwater and Drainage:

The site has not been fully assessed for soakage design or groundwater control. As a minimum, all upslope areas of building platforms, building foundations and driveways will have appropriate subsoil drainage constructed to prevent underground water flows affecting these areas. Localised seepages may also be encountered throughout the site and shall also be diverted with appropriate subsoil drainage.

The loessial soils are erodible and possibly dispersive which can lead to significant tunnel gullying and scouring where left exposed to overland water flows. Therefore, appropriate swale drainage shall be constructed to intercept overland water flows. Where low spots occur during site development, they shall be re-contoured to remove the possibility of surface ponding. Due to the soils having fine silt and clay particles, all subsoil drainage shall be protected with appropriate geo-filter fabrics to reduce soil mobilisation through into the more porous filter aggregates.

Due to the steep sloping topography of the site and the proximity of the Lots it is not recommended to construct attenuating stormwater ponds or septic soakage pits. A piped stormwater and foul drainage system should be adopted and connected to approved DCC infrastructure.

Liquefaction Potential:

The site topography, potential depth to groundwater table and the typical soils reported and observed determine the site to have an overall 'low' potential for liquefaction to occur. Should any subsequent specific investigations at any house platform location reveal a higher persistent water table and/or layers of weak or loose, fine grained and non-cohesive soils, then that specific site should be reappraised for liquefaction potential and the house foundations and earthworks design adjusted accordingly.

Land Stability:

There is a number of section of over steepened slopes above the driveway in the northwest area of the site that has slumped and is undermining the fence posts above. The slippage is likely due to the steep bank suffering ongoing erosion and wetting causing the soils to become too weak to support the slope angle. The two power poles on the northwest side of the site were noted to be leaning forward. This either due to ongoing soils creep or shallow embedment within the soft upper stratum of loess. As there were no signs of undulating ground surrounding the area, the leaning pole is likely due to shallow embedment.

There is no further evidence of land slumping or slippages throughout the upper areas and east side of the site. However, it is noted that these soils on steep slopes typically >20 degrees, can become susceptible to land slippage when saturated during periods of high ground water levels or where they are formed over steep. Slope stability will also be affected by increase in filled slope gradient, surcharging of the slope and large sustained seismic events.

There are recorded historical large landslides further upslope out with the site and appropriate hazard assessment should be given to whether these landslides present an issue to the proposed development were there to be any development undertaken on those landslides by others.

Specific geotechnical analysis may be required where engineered slopes are to be formed steeper than the recommended gradients or higher than 2.5m to 3.0m vertical height. Where slopes are to be over steep then retention should be considered, with specific engineering design required.

Potential Construction Issues:

Due to the steep topography of the site and the loess potentially being a dispersive soil, the earthworks will possibly have issues with sediment migration during prolonged rain events which may affect the neighbouring properties. Sediment and erosion control measures must be in place prior to any earthwork's construction to prevent uncontrolled sediment migration onto the neighbouring properties. Staged earthworks may also be required to prevent long term exposure to the loessial soils.

Tree roots will be encountered across the centre, lower north, and eastern areas of the site where trees and tree stumps are present. Where the tree stumps lie within the building footprint, the stumps and large root boles shall be fully grubbed out and the voids backfilled with engineering fills.

A detailed site earthworks plan of the access road and retaining walls should consider the recommendations made in this report and the final design shall be reviewed by a geotechnical engineer. Any future detailed or complex design and individual Lot development will require further investigation or testing to verify the assumptions made in this report.

I trust this report provides sufficient information to continue with the envisaged residential sub-division and development. Please do not hesitate to contact the undersigned if you need further clarification.

Yours sincerely,

James Molloy
For Terra MDC Ltd

Enclosures:

- Plates 1 to 5 from Site Reconnaissance
- Site Investigation Location Plan
- Test Pit and Scala Penetrometer logs
- Terramark subdivision layout plan 12178

Plate 1: View of the driveway entrance with stacked rock retaining wall in the background.

Plate 2: View of the mid area of the site looking up at the existing house.

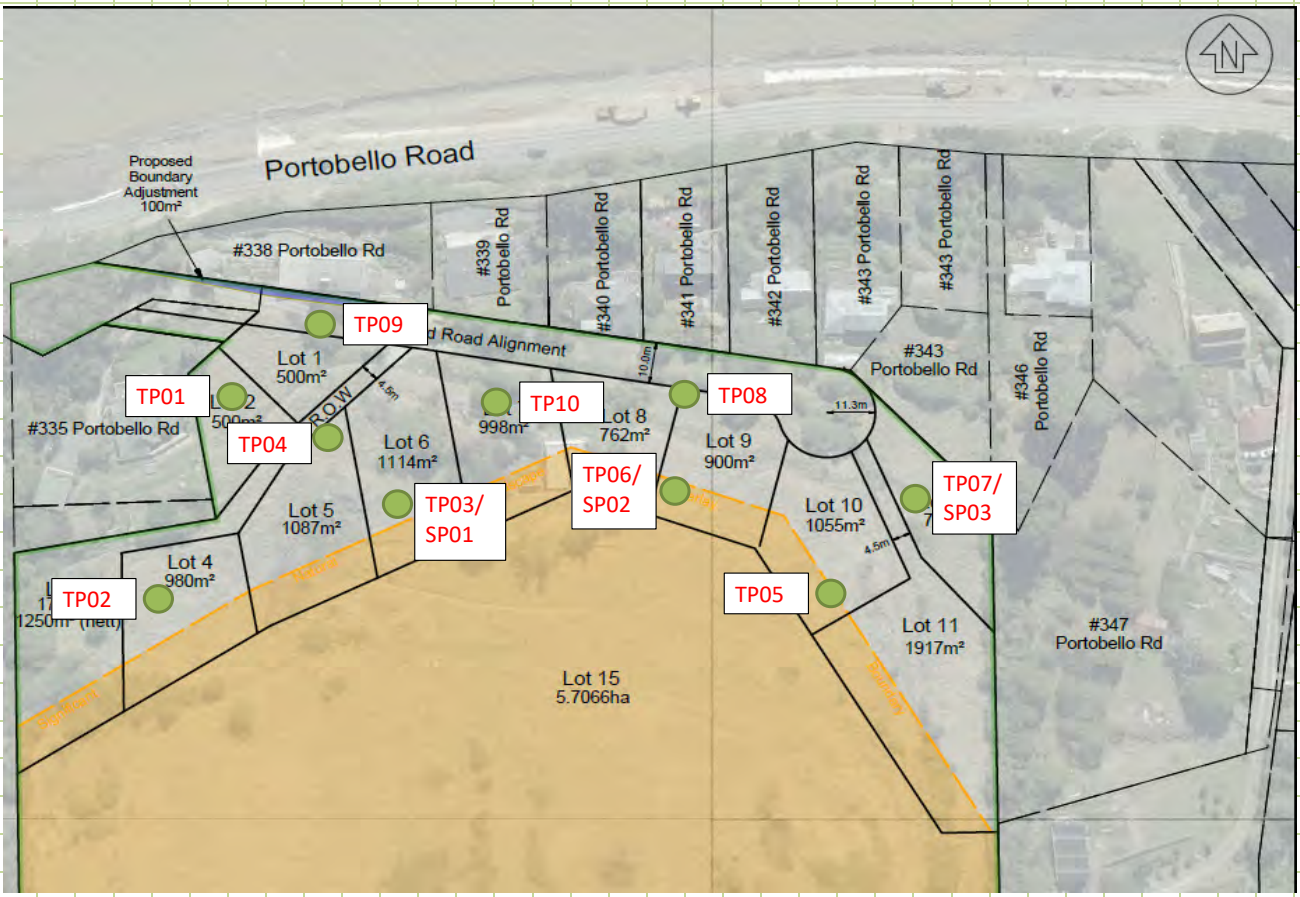
Plate 3: View looking east along the existing farm track from the midpoint of the proposed road alignment.

Plate 4: View looking southeast over the eastern area of the site.

Plate 5: View looking southwest over the western area of the site.

SKETCH SHEET

PROJECT: 336 Portobello Rd	**CLIENT: GTJM Property Ltd**	**SHEET**	**1**	**OF**	**1**
PROJECT No: 202106304	**SKETCH BY: Regan Lord**	**DATE: 21/06/2021**			
SUBJECT: Site Investigation Location Plan					



Key

Test Pit

Scala Penetrometer

Refer to test pit and scala logs for ground information

Terra & CONSTRUCTION MANAGED DESIGN

Contract Title: 336 Portobello Rd		Client: GTJM Property Ltd
Contract No.: 202106304		Weather: Sunny & clear
Date: 21/06/2021	Logged By: Regan Lord	Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP01**
Dry	0.0m—0.7m	Mottled grey and dark brown silty CLAY with minor coarse gravel and cobbles. Soft and in damp condition (Fill)	
	0.5m		
	0.7m—0.9m	Dark brown SILT. Soft and in damp condition. (Original topsoil)	
	0.9m—1.4m	Mottled grey and orange brown silty CLAY. Soft becoming firm with moderate plasticity and in dry to damp condition.	
	1.0m		
	1.5m	End of Test Pit at 1.4m	
	2.0m		
	2.5m		
	3.0m		
		Note: Hole stable and dry. 3 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP02**
Slow steady seepage at 0.5m	0.0m—0.25m 0.25m—1.3m 0.5m 1.0m 1.5m 2.0m 2.5m 3.0m	Dark brown topsoil with rootlets. Soft and in damp condition. Mottled grey and orange brown silty CLAY. Soft becoming firm with moderate to high plasticity and in damp condition. Large infilled cracks to 0.7m. End of Test Pit at 1.3m	
		Note: Hole stable and dry. 3 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP03**
Dry	0.0m—0.3m 0.3m—1.6m 0.5m 1.0m 1.5m 1.6m—1.75m 2.0m 2.5m 3.0m	Dark brown topsoil with rootlets. Soft and in damp condition. Mottled grey and orange brown silty CLAY. Soft becoming firm with moderate plasticity and in damp condition. Large infilled cracks to 0.9m Dark brown and grey clayey SILT. Stiff becoming hard and in dry to damp condition. (Weathered Tuff) End of Test Pit at 1.75m Note: Hole stable and dry. 3 photos. Backfilled with arisings. Bag Sample at 1.0m—1.5m.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP04**
Dry	0.0m—0.25m 0.25m—0.4m 0.5m 1.0m 1.5m 2.0m 2.5m 3.0m	Dark brown topsoil with rootlets. Soft and in damp condition. Mottled grey and orange brown silty CLAY. Soft with moderate plasticity and in damp condition. End of Test Pit at 0.4m	
		Note: Hole stable and dry. 2 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP05**
Dry	0.0m—0.3m	Dark brown topsoil with rootlets. Soft and in damp condition.	
	0.3m—1.2m	Mottled grey and orange brown silty CLAY. Soft becoming firm with moderate plasticity and in damp condition.	
	0.5m		
	1.0m		
	1.2m—1.4m	Dark brown and grey clayey SILT. Stiff becoming hard and in dry to damp condition. (Weathered Tuff)	
		End of Test Pit at 1.4m	
	1.5m		
	2.0m		
	2.5m		
	3.0m		
		Note: Hole stable and dry. 3 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP06**
Slight seepage at 0.4m	0.0m—0.25m 0.25m—1.05m 0.5m 1.0m 1.05m—1.3m 1.5m 2.0m 2.5m 3.0m	Dark brown topsoil with rootlets. Soft and in damp condition. Mottled grey and orange brown silty CLAY. Soft with high plasticity and in damp to wet condition. Large infilled cracks to 0.7m. Dark orange brown silty CLAY. Firm to stiff with moderate plasticity and damp condition. End of Test Pit at 1.3m	
		Note: Hole stable and dry. 5 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP07**
Dry	0.0m—0.3m	Dark brown topsoil with rootlets. Soft and in damp condition.	
	0.3m—0.9m	Mottled grey and orange brown silty CLAY. Soft becoming firm with moderate to high plasticity and in damp condition.	
	0.5m		
	0.9m—1.25m	Dark brown and grey clayey SILT. Stiff becoming hard and in dry to damp condition. (Weathered Tuff)	
	1.0m		
		End of Test Pit at 1.25m	
	1.5m		
	2.0m		
	2.5m		
	3.0m		
		Note: Hole stable and dry. 3 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP08**
Dry	0.0m—0.25m 0.25m—0.8m 0.5m 1.0m 1.5m 2.0m 2.5m 3.0m	Dark brown topsoil with rootlets. Soft and in damp condition. Mottled grey and orange brown silty CLAY. Soft with moderate to high plasticity and in damp condition. End of Test Pit at 0.8m	
		Note: Hole stable and dry. 2 photos. Backfilled with arisings.	

Contract Title: 336 Portobello Rd		Client: GTJM Property Ltd
Contract No.: 202106304		Weather: Sunny & clear
Date: 21/06/2021	Logged By: Regan Lord	Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP09**
Dry	0.0m—0.3m	Dark brown clayey SILT with minor coarse gravel. Soft and in damp condition. (Fill)	
	0.3m—0.5m	Dark brown SILT Soft and in damp condition. (Original topsoil)	
	0.5m—1.0m	Mottled grey and orange brown silty CLAY. Soft with moderate plasticity and in damp condition.	
	0.5m		
	1.0m	End of Test Pit at 1.0m	
	1.5m		
	2.0m		
	2.5m		
	3.0m		
		Note: Hole stable and dry. 1 photo. Backfilled with arisings.	

Contract Title: 336 Portobello Rd
Contract No.: 202106304
Date: 21/06/2021
Logged By: Regan Lord
Client: GTJM Property Ltd
Weather: Sunny & clear
Excavator: 7T excavator (Hyundai 70cr-9)

Water @	Depth	Soils Description	**TRIAL PIT No. TP10**
Dry	0.0m—0.4m	Dark brown clayey SILT with roots throughout. Soft and in damp condition. (Fill)	
	0.4m—0.6m	Dark brown SILT Soft and in damp condition. (Original topsoil)	
	0.5m		
	0.6m—1.4m	Mottled grey and orange brown silty CLAY. Soft with moderate plasticity and in damp condition.	
	1.0m		
	1.5m	End of Test Pit at 1.4m	
	2.0m		
	2.5m		
	3.0m		
		Note: Hole stable and dry. 3 photos. Backfilled with arisings.	

Scala Penetrometer Test Results

Project: 336 Portobello Rd
Job Number: 202106304
Location : As per Site Investigation Location Plan
Client : GTJM Property Ltd

Tested: R.L.
Checked: J.M.
Date: 21/06/2021
Refusal = 12 > 10 or 1 > 50

Test Location: SP01				Test Location: SP02				Test Location: SP03				Test Location:			
Depth (mm)	No. Blows	Equiv. CBR%	Q_a (kPa)	Depth (mm)	No. Blows	Equiv. CBR%	Q_a (kPa)	Depth (mm)	No. Blows	Equiv. CBR%	Q_a (kPa)	Depth (mm)	No. Blows	Equiv. CBR%	Q_a (kPa)
0	0	0	#N/A	0	0	0	#N/A	0	0	0	#N/A	0			#N/A
100	1	2	25	100	1	2	25	100	0	0	#N/A	100			#N/A
200	2	4	70	200	2	4	70	200	1	2	25	200			#N/A
300	2	4	70	300	2	4	70	300	2	4	70	300			#N/A
400	2	4	70	400	3	6	100	400	1	2	25	400			#N/A
500	2	4	70	500	2	4	70	500	1	2	25	500			#N/A
600	3	6	100	600	2	4	70	600	2	4	70	600			#N/A
700	2	4	70	700	2	4	70	700	1	2	25	700			#N/A
800	3	6	100	800	2	4	70	800	2	4	70	800			#N/A
900	6	13	175	900	4	8	130	900	4	8	130	900			#N/A
1000	10	23	260	1000	10	23	260	1000	6	13	175	1000			#N/A
1100	15	36	325	1100	15	36	325	1100	15	36	325	1100			#N/A
1200			#N/A	1200			#N/A	1200			#N/A	1200			#N/A
1300			#N/A	1300			#N/A	1300			#N/A	1300			#N/A
1400			#N/A	1400			#N/A	1400			#N/A	1400			#N/A
1500			#N/A	1500			#N/A	1500			#N/A	1500			#N/A
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2600			#N/A	2600			#N/A	2600			#N/A	2600			#N/A
2700			#N/A	2700			#N/A	2700			#N/A	2700			#N/A
2800			#N/A	2800			#N/A	2800			#N/A	2800			#N/A
2900			#N/A	2900			#N/A	2900			#N/A	2900			#N/A
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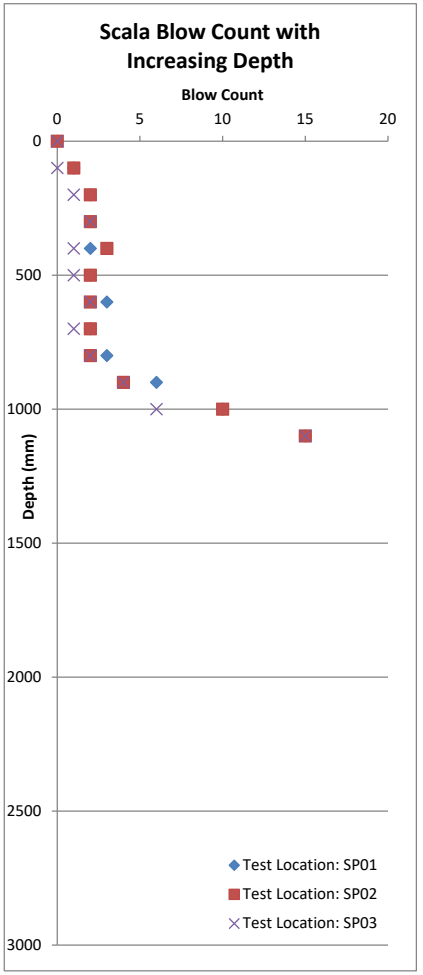
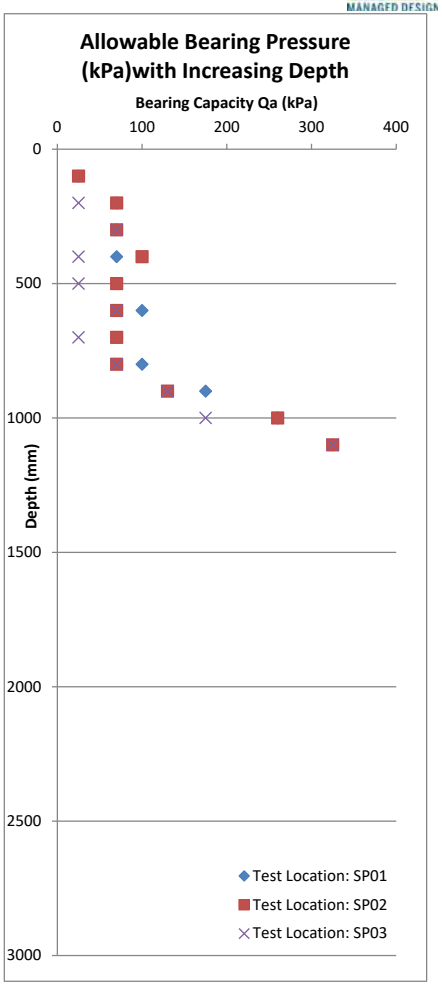
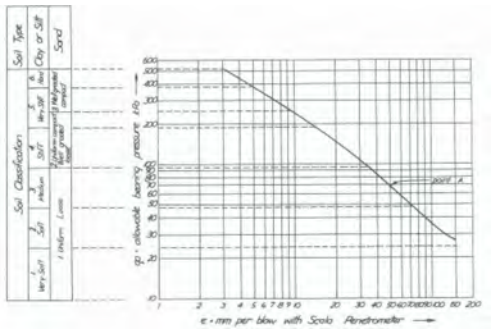




Note: CBR % and Allowable Bearing Capacity are a correlation taken from M.J. STOCKWELL (1977), 'Determination of allowable bearing pressure under small structures'

Recorded Blows 100mm	Blows / 100mm	Qa (kPa) - from chart	Recorded Blows 100mm	Blows / 100mm	Qa (kPa) - from chart
1	100.00	25	11	9.09	270
2	50.00	70	12	8.33	280
3	33.33	100	13	7.69	290
4	25.00	130	14	7.14	310
5	20.00	160	15	6.67	325
6	16.67	175	16	6.25	340
7	14.29	190	17	5.88	355
8	12.50	210	18	5.56	370
9	11.11	235	19	5.26	380
10	10.00	260	20	5.00	390



terramark
setting new boundaries
Surveying, Resource Management, & Engineering Consultants

PROVISIONAL ONLY

NUMBER OF LOTS, AREAS, DIMENSIONS & DETAILS ARE SUBJECT to TOPOGRAPHIC SURVEY, RESOURCE CONSENT, DETAILED ENGINEERING DESIGN & FINAL SURVEY

DRAWING STATUS

CONCEPT ONLY
CONFIDENTIAL
NOT FOR CIRCULATION

Project Title:

Preliminary Concept Plan Version 2

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Address:

336 Portobello Rd
Dunedin

Legal Description:

Client:

GTJM Property Ltd

Area:	Title Reference:
	Multiple
Date:	Scale (A3):
18/02/2021	1:1000

Job No:	Plan No:	Revision:
12178	4	-

APPENDIX 3
REPORT RESPONDING TO SECTION 42A AND MATTERS RAISED IN SUBMISSIONS

5 August 2022
Terra MDC Limited
82 Bond Street,
Central City
Dunedin 9016
New Zealand

Ph/Fax: +64 (0) 3 477 0090
Mob: +64 (0) 220 737 480
E-mail: james.molloy@terramdc.co.nz
Web: www.TerraMDC.co.nz

For attention: Joe Morrison
GTJM Property Limited
46 Finnie Rd,
RD1 Dunedin, 9076
(by email only)

Project Reference: 202106304

Dear Joe,

RE: Review of the Preliminary Engineering Designs for the Proposed Subdivision at 336 & 336A Portobello Rd, Dunedin

Introduction:

This letter provides a geotechnical review of the supporting concept engineering designs which have been prepared for your proposed sub-division at the above site. The intention is to clarify as to whether the site suitability has been assessed in sufficient detail at this early stage, insofar that the Dunedin City Council's (DCC) rezoning of the land can be undertaken with confidence and your development can then progress into the necessary detailed investigation and engineering design for the development.

It is understood your intention is to subdivide the lower northern end of the property into 12 Lots with proposed improvements and regrading of the existing road alignment formed from Portobello Rd along the northern boundary along with the necessary infrastructure to service each of the individual residential Lots 1 to 9. The Lots 11 and 12 are roading access, and Lot 10 is dedicated to the Significant Natural Landscape (SNL). The information for this development is presented in the following documents:

- A concept subdivision layout plan provided by Terramark (refer attached drawing: *Scheme Plan for Resource Consent 12178*-5, dated 2 August 2022).
- The concept design Weller Street and Shared Access (Lot 11) undertaken by GHD Limited (refer drawings: "*Weller St - Concept Design*": sheets 12537363- G001, C010, C011, C020, C051-C053).
- The concepts for the three waters (Water, Waste and Stormwater) systems necessary for the development provided by Fluent Solutions (refer report: "*Water, Wastewater and Stormwater Infrastructure Assessment*", October 2021).

There is no detail provided for new power or telecoms supply, other than you intend for the power lines on poles currently spanning the site to be lowered and diverted underground.

The current application for DCC rezoning has met with objections from adjacent landowners or occupants which are summarised in Section 5.2.12 (pp 153-161) of the DCC Section 42A "*Additional Housing Capacity – Part 3 - Sites Proposed for Rezoning*",15 July 2022. These objections relate to land instability, stormwater control, roading access notably off Portobello Rd and the gum trees growing along the access road.

Furthermore, it is noted a letter dated 6 May 2022, has been written to you by a number of the neighbours (all now noted as submitters either in opposition or rejecting the Plan change) along with a copy of the Geological & Nuclear Sciences (GNS) 2007 report "*Guidelines for Assessing Planning Policy and Consent Requirements for Landslide Prone*

Land". That letter, whilst it indicates there is no opposition to the sub-division in principle, outlines the concerns of the writers on four heads, described in summary below:

- ***Slope instability and landslide risk*** – this point is more detailed than the following three points insofar that it highlights what are described as the main issues around potential loss of life or property and in summary seeks confirmation that a hazard and land stability assessment will be undertaken. Their request is for the land stability assessment to be undertaken for the land including all driveways and building platforms detailed, with this to reference the GNS 2007 report provided.
- ***Associate liability*** – this point seeks confirmation on the construction works affecting the long term stability, along with confirmation that the necessary infrastructure works would be fully completed.
- ***Vehicle access during construction*** – this point seeks confirmation of appropriate communication for any necessary temporary road closures and potential delays to residents.
- ***Gum trees*** – this point seeks the option for a covenant or an agreement to be made upon the large gum trees at the Portobello Road frontage to prevent their removal, unless it is otherwise determined that their removal is necessary for the Weller Street realignment or they present a hazard to their driveways' stability.

A technical Memorandum has been provided by Stantec, who act as geotechnical advisor to DCC, (refer: "*2GP Rezoning Sites*", 6 May 2022), in which this site is commented upon as "*GF14: 336 & 336A Portobello Rd, The Cove*". It is recognised in Stantec's review that the GF14 site is yellow coded 'Medium Level Hazards' as it predominantly is on geological formations where shallow slope failures typically could occur. However, it notes also that the development site slopes are generally less than 26°. The global stability of any steeper land than 26° needs to be considered by the development and geotechnical advice should be sought on the existing instabilities to ensure these do not affect the development. The GNS 2007 report is a guideline for Planning and Policy development at a regulatory level and it is assumed that Stantec will be conversant with this document.

The Stantec view presented is that slopes generally slacker than 20° are typically stable unless over excavated (i.e. undermined) or where groundwater run-off is uncontrolled, and where this is the case then a specific geotechnical investigation and engineering design for the development should be undertaken. Alternatively, an appropriate buffering by exclusion zones delineating an area of global land instability from the development may be also an option. In summary, Stantec recommend that the site is not excluded from development but will require specific engineering assessment in the areas of steeper land.

These points raised by the DCC, Stantec, and local residents are addressed in the discussions and summary below.

Terra MDC 2021 Geotechnical Assessment:

The site was investigated and reported upon by Terra MDC – refer to "*Preliminary Geotechnical Assessment of Land for the Proposed Subdivision at 336 Portobello Rd, Dunedin*". This report provides a preliminary investigation and assessment of the site for the proposed 12 Lot sub-division. The report is overall supportive of the development with the following matters discussed and recommendations provided for the concept roading and drainage design to be developed.

Ground stability – global / localised ground instability:

Global instability may be defined as the significant and deep seated failure of large elements of a soil and/or rock slope and are more often termed a 'landslide'. There is no obvious evidence on the site or within the available archive and publicly reported information for global instability having previously occurred within this 12 Lot development site. There are three areas higher up above Highcliff Road identified on GNS mapping which may be considered as global instability or a landslide (Stewart 1996). These are reported as "historical" and "have no record of recent movement". These landslides flank the site for development and are focussed into existing gullies formed on the east and west edges of the overall Lot 10 which will form the SNL. These three landslides in their current form do not present an immediate hazard to any downslope property owners including those future property owners of the proposed development.

Local instability may be defined as a more discrete and shallow soil and/or rock slope failure, which could locally affect, for example, the road cutting, foundations for embankments or house foundations. These are termed a 'land slippage'. It is noted in the Terra MDC report that small and shallow land slippages can be observed on the site. These are due to oversteep slopes excavated along the farm access track and in areas of non-engineering fills previously placed. These existing land slippages are small in scale (typically 2m to <5m wide) and their failure plane is at a shallow depth, with minimal run-out of the slippage debris. These small landslips, which are observed as over steep filled slopes placed upon an original slope (i.e. non-engineered fill) are likely exacerbated by surface flows which naturally occur down the paddocks and can become routed along the previously formed farm tracks.

The residents in their letter of 5 May 2022 identify a land slippage on the property of previous owner Alan Beveridge. This is confirmed by you as a small land slippage off the oversteep excavated slope overlooking the formed driveway nearest the driveway gate adjacent to the block of land - 336A Portobello Rd. This land slippage does not present an immediate hazard to any downslope property and will be remediated during the development.

It is recommended in Terra MDC's 2021 report that these minor areas of pre-existing land instability are remediated by removing them and the land reformed to a designed stable slope with engineered fills retaining, walls or the slopes excavated to a stable inclined slope. Likewise, it is recommended all the unsuitable non-engineered fill or soft natural soils are removed with any voids formed to be replaced with engineered fills. Suitable sub-soil and channelled or piped stormwater drainage are proposed to be designed and constructed to control the stormwater run-off, including to mitigate the erosive and surcharging effects of water.

A specific point is raised about the mature gum trees which are growing along Weller Street as there appears to be concern these may present a future hazard to the neighbouring driveways. These gum trees are of a size and age that they can cause land instability to occur. Firstly, by root jacking whereby roots grow into cracks forcing the rock joints open which permits water ingress and the loss of frictional contact. Secondly where during and after inclement weather and with high winds the tree can act as a 'lever' and fully displace significant blocks of land when toppling. The gum trees have been preferentially pruned on the hill side, presumably to maintain clear access up the driveway which in turn further exacerbates the 'lever' action as the trees are heavier on the Portobello Rd side. It is the authors experience, including as recently as the July 2022 flood events, that these large tree falls have regularly occurred along the length of Portobello Road, which gives rise to hazards to both landowners and the public on the road. The local residents have already indicated in principle that the gums could be removed for the benefit of the Weller Street intersection improvements or where a hazard to driveway stability can be independently shown.

Proposed excavated and filled slopes:

The existing excavated and filled slopes for the existing house platform (now demolished) and the farm access tracks are noted in the report as steeper than the recommended angle of inclination. It is recommended these slopes are formed at slacker and stable slopes using appropriate engineering fills or excavated to an angle of 20^{o} or less. These design slopes are specified in similar hillslope development by the author around Dunedin. Where the slopes are formed higher than 3m a specific slope stability analysis is also recommended to further guide the final design.

Retaining walls:

If, due to land constraints or where these slopes are unable to be formed then a retaining wall may be formed. This would require investigation and design, including slope stability analysis. The concept layout by Terramark and GHD roading design recognise areas where retaining walls will be required. The retaining wall design will need to be designed by an appropriately qualified person and signed off by a chartered engineer. This is due to the surcharging effect of the upper slopes, the driveway loadings and where the retaining walls heights exceed 1.5m.

Ground and surface water control:

The necessity for control of groundwater and surface water flow is recognised in the report. The recommendation provided is for appropriate sub-soil drainage to intercept groundwater flows and localised seepages such that the near surface land stability would be enhanced due to being permanently drained.

It is also confirmed the upper layers of soils are susceptible to erosion which can lead to scour and tunnel gullying. This should be a consideration in the design including the use of suitable geo-filters to mitigate soil losses.

It is also noted there should be interception drainage formed so groundwater does not flow uncontrolled across the new Lots or road, with no onsite attenuation or seepage systems to be adopted. It is recommended the piped stormwater and wastewater drainage system be adopted and connected to approved DCC infrastructure.

Proposed Roading Design:

The GHD concept design has presented a plan of the realignment of Weller Street from the intersection to Portobello Road up to the full length of the new access way with supporting long and cross-sections also provided. The road runs in an east-west orientation following the existing narrow single lane Weller Street and the lower farm track traversing up the hill slope.

The long section showing the proposed vertical alignment shows at the centreline of the proposed roadway it is at near grade, i.e. close to the existing ground level. The cross-sections show the centreline at near grade. Due to the proposed widths of road pavement and footpath it requires retaining on the uphill side, engineered filling and, in locations, retaining on the downhill side, with an 'indicative timber pole retaining structure'.

There is no driveway access to each Lot defined but this would by necessity be provided in the detailed design for the site development. These driveway accesses would likely require a return to be formed from the road retaining wall into the driveway, with slopes graded out into the natural upper slopes. These driveway access formed into slopes will likely be an inclined ramp and would normally be paired to Lot boundaries to reduce the retaining walls.

The concept design prepared by GHD does not present any overly complex or non-standard design options for the development roading realignment and intersection, nor does it present any issues which are considered likely to worsen the geotechnical issues faced by the project.

The detailed design of the roading and necessary earthworks, drainage and retaining will need to be confirmed that they comply with DCC's design requirements for roading which is a process that would be undertaken during the detailed design stage.

Proposed Three Waters Design:

The three waters design is a concept report for water supply, wastewater and stormwater discharge systems. This summary review relates to the proposal for stormwater management. The current concept is for the stormwater to be collected into kerb and channel then mud-tanks and pipes which then discharged to the harbour via either a new or existing culvert under Portobello Road.

The access road down to Weller Street bisects across and below the new residential lot and is of a relatively uniform gradient. This will intercept the stormwater run-off from above which will be all gravity discharge. The stormwater collection system will also provide for any groundwater seepages or retaining wall drainage to be collected and discharged. This, in effect, will significantly improve the run-off experienced by the lower neighbours bounding the proposed new development. The road design would likely, through final detailed design, provide for secondary overland flows down the road, which in any significant flood event will also considerably improve the downslope conditions for the neighbours on the lower bounding sites.

The detailed design of the three waters systems will need to be confirmed that they comply with DCC's design requirements for the three waters which is a process that would be undertaken during the detailed design stage.

Inspection following Recent July 2022 Rain Event:

An inspection of the site for development was undertaken by the author on 2 August 2022, following the sustained periods of rainfall over period 12 to 15 July and 25 to 28 July. The site had undergone some minor earthworks for improvement of a driveway access into the rear of 339 Portobello Rd preceding those weather events with silt fences and sediment control measures installed along the lower site boundary. It was noted there was no evidence of sustained stormwater runoff that could be assessed as anything other than normal discharges from a site such as this. The current sediment control measures appeared to be effective, in that there was no obvious silt or discharges down Weller Street. In the course of the inspection, particular attention was paid to the stability of the steeper slopes around the rear of the now demolished house and along the farm access tracks. These was no evidence of

any new instability observed, but there were a number of ground water seepages present at the toe of slopes. The detailed design for stormwater would need to address those seepages with appropriate interception drainage.

Summary and Conclusions

In light of the scale of proposed roading and earthworks it is the considered opinion of the author that the development, with appropriate design, would not affect the global or local stability of the hillslopes. It is necessary to have appropriate and specific engineering design for the roading and driveways accesses, groundwater and stormwater drainage, earthworks and any bulk infilling of landscaping.

Further geotechnical investigation and design will be necessary, including stability analysis of slopes and retaining walls. The geotechnical investigation design would also present information for roading and structural designs for the development to enable the detailed design to meet current standards and guidelines for urban development. The DCC requirements would need to be confirmed and integrated during that design phase.

Regarding the concept roading and stormwater designs, it is considered, that with appropriate detailed design to support it, the lower neighbour's situation will be improved with regards to run off and sediments that would naturally discharge down from the paddocks currently above them.

The need for a specific design of the house building platforms is not considered necessary for the sub-division development as this would be a significant determinate on the house types that are constructed in the future.

The existing gums trees at Weller Street should be inspected and assessed by an appropriately qualified person for determination of their long term viability and the potential hazard they present to both the landowners and visitors using Weller St and the public using Portobello Rd.

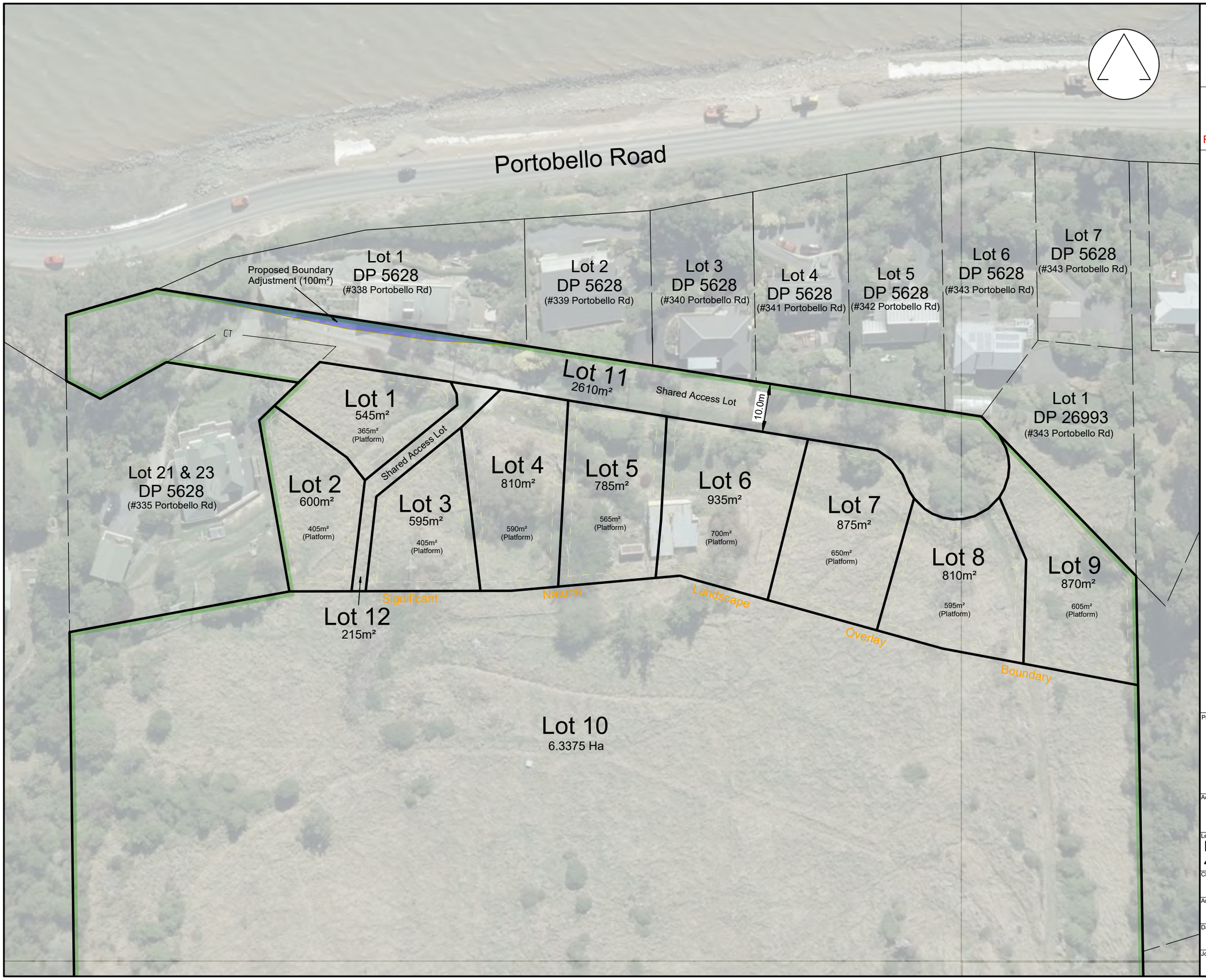
In consideration of the above I would advise it in my view the concept designs presented by GHD and Fluent Solution, along the previously presented geotechnical assessment are suitable at this stage of the development, notably so in addressing the land stability and stormwater issues raised by the adjacent landowners. I trust this enables you to proceed with to your rezoning application of this property.

Yours sincerely

James Molloy
for Terra MDC Ltd

Enclosures:

- *Terramark - Scheme Plan for Resource Consent 12178-5, dated 2 August 2022*
- *Plates 1 to 6 from Site Reconnaissance 2-8-22 following July 2022 Flood Event*



terramark
setting new boundaries
Surveying, Resource Management, & Engineering Consultants

PROVISIONAL ONLY

DETAIL, AREAS & DIMENSIONS ARE SUBJECT TO FINAL DESIGN, RESOURCE CONSENT & FINAL SURVEY

Project Title:
Lots 1 - 12 Being a Subdivision of Lots 22 & 25 DP 5628 & Pt Section 45 - 46 Upper Harbour East Survey District

Address:
336 & 336a Portobello Road
The Cove

Legal Description:
Lots 22 & 25 DP 5628 & Pt Sec 45 - 46 Upper Harbour East SD

Client:
GTJM Property Ltd

Area:	Title Reference:
7.3025 Ha	
Date:	**Scale (A3):**
02/08/2022	1:750

Job No:	Plan No:	Revision:
D12178	5	A

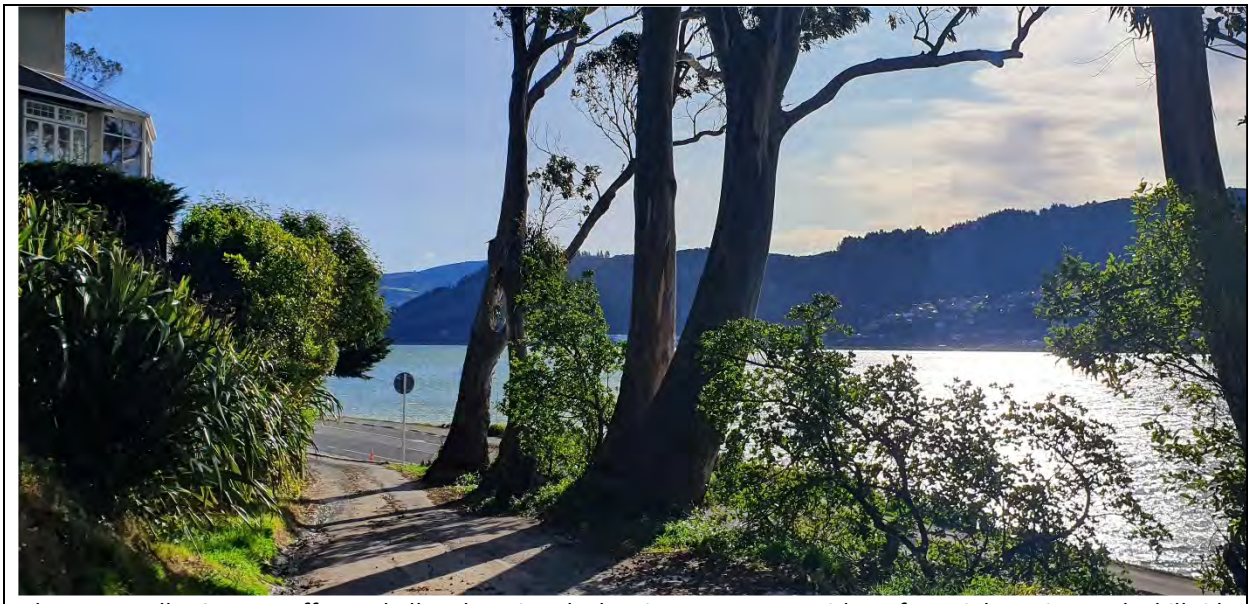


Plate 1: - Weller St entry off Portobello Rd, noting the leaning gums trees with preferential pruning to the hill side

Plate 2: View further up Weller St at single lane accessway to the site with random rubble rock wall in upper area.

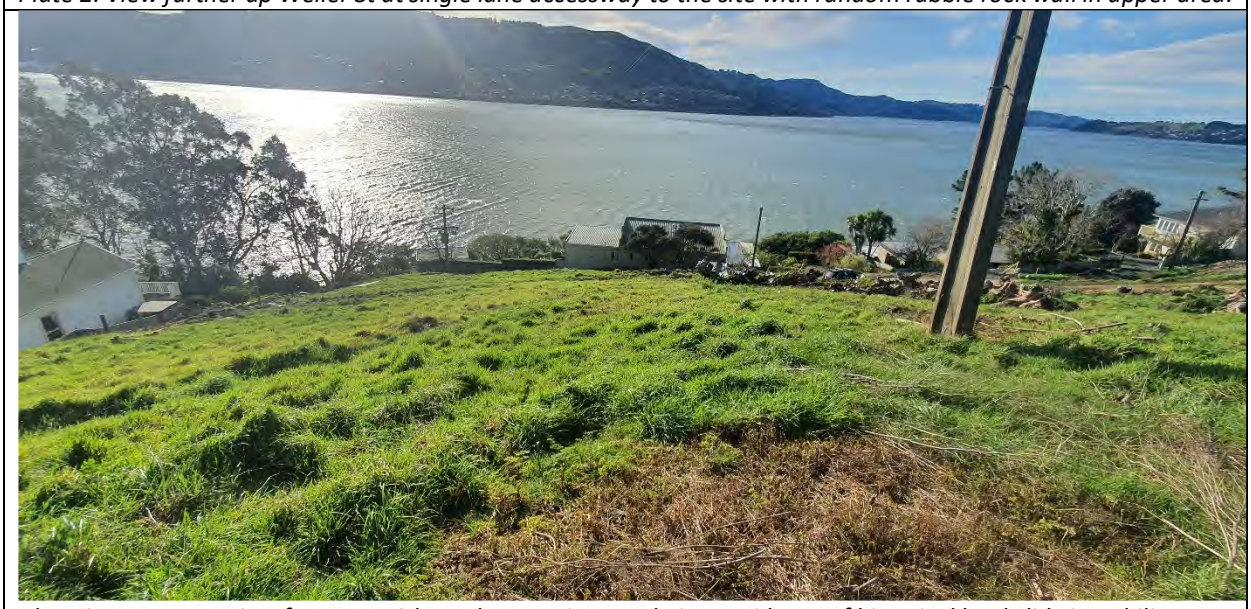


Plate 3: Panorama view from Lot 10 boundary, noting no obvious evidence of historical land slide instability

Plate 4: Looking down on demolished house site with over steep formed slopes and non-engineered fills at front.

Plate 5: View at intended upper roundabout location where three farms track intersect, with little erosion noted.

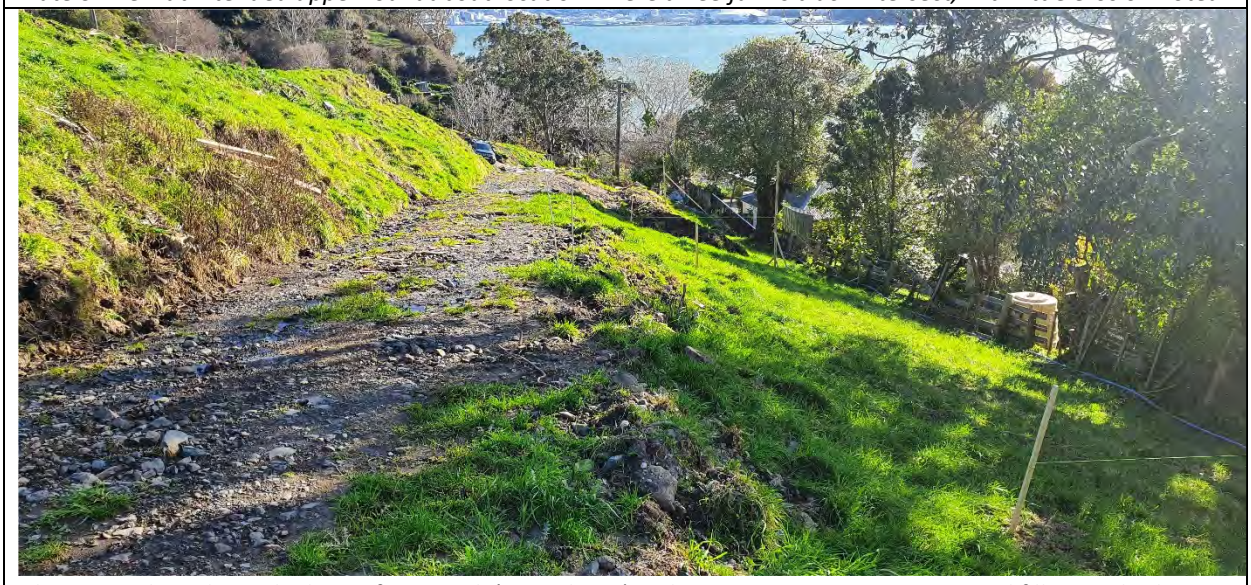


Plate 5: Looking down the lower farm track (GHD ch250) with existing steep non-engineered fills on side slopes