Table 1: NDMA Issues and Potential Mechanisms For Solutions

Notified Policy / Rule	Issue	Potential Solutions
CHANGE D4 **Policy 2.3.3.1.X** Support community and leisure activity, sport and recreation, and essential community facilities in Dunedin through: ... X. policies and assessment rules for subdivision in a **new development mapped area** that require consideration of the need for formal and/or informal space for recreation, sporting, social and cultural activities, and community facilities. ***{Change D4}*** **Delete Polcy 2.6.1.6.b** **Objective 12.2.X** Future residential growth areas are developed in a way that achieves the Plan's strategic directions for: ***{Change D1}*** a. facilities and spaces that support social and cultural well-being (Objective 2.3.3); ***{Change D4}*** **Policy 12.2.X.1** Policy 12.2.X.1 — Only allow subdivision in a **new development mapped area** where it will provide or otherwise ensure good access to outdoor recreation opportunities (including playgrounds) and, where possible, opportunities for off-road cycling and walking tracks within and between different residential developments and connecting to community facilities and services. ***{Change D4}*** **Rule 12.X.2.5.c** **12.X.2 Assessment of restricted discretionary activities in a Transition Overlay Zone or mapped area** Activity | Matters of discretion | Guidance on the assessment of resource consents ...	How will this operate in NDMA where land is in multiple ownership and development is likely to occur over time and potentially without co-operation between landowners? S32 report talks about 'large greenfield areas' [see para 296], however, many of the 'large greenfield areas' in NDMA are in multiple ownership.	A trigger mechanism for requirement of formal and/or informal space for recreation, sporting, social and cultural activities, and community facilities. That is, over so many lots / developed area a greenspace is required. AND / OR Specify what greenspace etc is required as a minimum for which NDMAs.

5.	In a **new development mapped area**: • All subdivision activities *{Change D1}*	c. Provision of recreation spaces *{Change D4}*	*Relevant objectives and policies:* i. Objective 12.2.X ii. The subdivision provides or otherwise ensures good access to outdoor recreation opportunities (including playgrounds) and, where possible, opportunities for offroad cycling and walking tracks within and between different residential developments and connecting to community facilities and services (Policy 12.2.X.1). *{Change D4}* *Conditions that may be imposed include:* iii. Location, size and shape of recreation reserves, including a minimum length of road frontage. iv. A requirement to vest recreation spaces in DCC as DCC reserve. v. Public amenities to be included in a recreation reserve. vi. A requirement for the recreation space to be developed prior to vesting in DCC. *{Change D4}*		

Rule 15.11.5.Y

15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item		
Activity	Matters of discretion	Guidance on the assessment of resource consents

...

Y.	In a **new development mapped area**: • All subdivision activities *{Change D1 & Change F2-2}*	c. Provision of recreation spaces *{Change D4}*	See Rule 12.X *{Change D4}*

Notified Policy / Rule	Issue	Potential Solutions
CHANGE D5 **Delete Policies 2.2.2.5.b and 2.2.5.3.a and replace with new clause in Policy 2.2.2.X.a** Policy 2.2.2.X to be added {Change D5 & Change E4} Encourage improvements to the environmental performance of new housing by: ***{Change E4}*** a. use of policies and assessment rules for subdivision, including in **new development mapped areas**, that encourage subdivisions to be designed to maximise the potential for passive solar design in housing; ***{Change D5}*** b. encouraging new medium density housing in parts of the city that have old housing stock that is not protected for its heritage values; c. rules that require outdoor living space to be on the sunny side of buildings, and requiring principal living areas to connect to the outdoor living space; and d. rules that restrict height in relation to boundary to facilitate access to sunlight in outdoor areas. ***{Change E4}*** **Objective 12.2.X & Policy 12.2.X.3** **Objective 12.2.X** *{Change D1}* Future residential growth areas are developed in a way that achieves the Plan's strategic directions for: ***{Change D1}*** **...** c. environmental performance and energy resilience (Objective 2.2.2); ***{Change D5}*** .. Policy 12.2.X.3 — Only allow subdivision in a **new development mapped area** where the subdivision layout and orientation provides for houses to be designed with good solar access to living areas and outdoor living spaces. ***{Change D5}*** **Rule 12.X.2.5.a** **12.X.2 Assessment of restricted discretionary activities in a Transition Overlay Zone or mapped area** Activity | Matters of discretion | Guidance on the assessment of resource consents **...**	**No issues.**	**N/A**

5.	In a **new development mapped area**: • All subdivision activities ***{Change D1}***	a. Whether subdivision design supports energyefficient housing ***{Change D5}***	*Relevant objectives and policies:* i. Objective 12.2.X ii. The subdivision layout and orientation provides for houses to be designed with good solar access to living areas and outdoor living spaces (Policy 12.2.X.3). ***{Change D5}***

...

Rule 15.11.5.Y

15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item

Activity	Matters of discretion	Guidance on the assessment of resource consents
...		
Y. In a **new development mapped area**: • All subdivision activities ***{Change D1 & Change F2-2}***	a. Whether subdivision design supports energy-efficient housing ***{Change D5}***	See Rule 12.X ***{Change D5}***

Notified Policy / Rule	Issue	Potential Solutions
CHANGE D6 **Objective 12.2.X and Policy 12.2.X.2** **Objective 12.2.X** *{Change D1}* Future residential growth areas are developed in a way that achieves the Plan's strategic directions for: ***{Change D1}*** ... b. indigenous biodiversity (Objective 2.2.3); ***{Change D6}*** ... Policy 12.2.X.2: Only allow subdivision in a **new development mapped area** where the subdivision is designed to ensure any future land use and development will protect, and where necessary restore, any waterways, areas of important indigenous vegetation and habitats of indigenous fauna, or other areas with significant natural environment values. ***{Change D6}*** **Rule 12.X.2.5.d** **12.X.2 Assessment of restricted discretionary activities in a Transition Overlay Zone or mapped area** Activity: ... Matters of discretion: d. Whether subdivision design maintains or enhances areas with significant natural environment values ***{Change D6}*** Guidance on the assessment of resource consents: *Relevant objectives and policies:* i. Objective 12.2.X ii. The subdivision is designed to ensure any future land use and development will protect, and where necessary restore, any waterways, areas of important indigenous vegetation and habitats of indigenous fauna, or other areas with significant natural environment values (Policy 12.2.X.2). ***{Change D6}*** *Conditions that may be imposed include:* iii. A requirement to protect areas through reserve status or other legal mechanisms. iv. A requirement to undertake conservation activity. ***{Change D6}***	What is the threshold for 'significant natural environment values'?	Provide a definition for this term.

Rule 15.11.5.Y

15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item

	Activity	Matters of discretion	Guidance on the assessment of resource consents
...			
Y.	In a new development mapped area: • All subdivision activities *{Change D1 & Change F2-2}*	d. Whether subdivision design maintains or enhances areas with significant natural environment values *{Change D6}*	See Rule 12.X *{Change D6}*

Notified Policy / Rule	Issue	Potential Solutions
CHANGE D7 **Objective 12.2.X {Change D1}** Future residential growth areas are developed in a way that achieves the Plan's strategic directions for: ***{Change D1}*** ... d. form and structure of the environment (Objective 2.4.1); ***{Change D7}*** **Policy 12.2.X.4** Policy 12.2.X.4: Only allow subdivision in a **new development mapped area** where the subdivision will provide adequate areas of amenity planting (including but not limited to street trees) and public amenities to ensure an attractive residential environment. ***{Change D7}*** **Rule 12.X.2.5.b** **12.X.2 Assessment of restricted discretionary activities in a Transition Overlay Zone or mapped area** Activity: 5. In a **new development mapped area**: • All subdivision activities ***(Change D1)*** Matters of discretion: b. Provision for amenity planting and public amenities ***(Change D7)*** Guidance on the assessment of resource consents: *Relevant objectives and policies:* i. Objective 12.2.X ii. The subdivision provides adequate areas of amenity planting (including but not limited to street trees) and public amenities to ensure an attractive residential environment (Policy 12.2.X.4). *Conditions that may be imposed include:* iii. Requirements for street tree and other subdivision amenity planting. ***(Change D7)*** **Rule 15.11.5.Y** **15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item** Activity / Matters of discretion / Guidance on the assessment of resource consents	What is the threshold for the requirement? What constitutes an 'adequate' area?	Include a trigger (i.e. number of lots / size of development area). AND / OR Provide guidance on what constitutes 'adequate' areas of amenity planting and public amenities.

Y.	In a new development mapped area: • All subdivision activities *{Change D1 & Change F2-2}*	b. Provision for amenity planting and public amenities *{Change D7}*	See Rule 12.X *{Change D7}*		

Notified Policy / Rule	Issue	Potential Solutions
CHANGE D8 **Policy 2.7.1.2** Ensure areas of new urban development provide for public infrastructure networks that represent the least possible long term cost to the public through: ... Z. policies and assessment rules for new development mapped areas that encourage efficient use of land as a way to maximise the cost effectiveness of public infrastructure delivery. ***{Change D8}*** **Objective 12.2.X {Change D1}** Future residential growth areas are developed in a way that achieves the Plan's strategic directions for: ***{Change D1}*** ... e. a compact and accessible city (Objective 2.2.4); and ***{Change D8}*** f. efficient public infrastructure (Objective 2.7.1). ***{Change D8}*** **Policy 12.2.X.5** Policy 12.2.X.5 — Only allow subdivision in a **new development mapped area** where the subdivision design ensures the efficient use of land, while also achieving the other elements of Objective 12.2.X. ***{Change D8}*** **Rule 12.X.2.5.e** **12.X.2 Assessment of restricted discretionary activities in a Transition Overlay Zone or mapped area**	Rule 12.X.2 – general assessment guidance iv.3 This assessment has already been undertaken in rezoning of the land (including placement of Transition overlay zone or mapped area).	Delete.

5. In a **new development mapped area**: • All subdivision activities *{Change D1}*	e. Whether subdivision design supports efficient use of land *{Change D8}*	*Relevant objectives and policies:* i. Objective 12.2.X ii. The subdivision design ensures the efficient use of land, while also achieving the other elements of Objective 12.2.X (Policy 12.2.X.5). *{Change D8}* *General assessment guidance:* iii. Council will generally require subdivision in a NDMA to enable the maximum development capacity allowed under the rules and as can be achieved while still achieving the other objectives and policies of the Plan (e.g. as many sites suitable for residential development as practicable or through other means of maximising development capacity). *{Change D8}* iv. Where a subdivision proposes a residential yield less than what is allowed by the zoning and where this is not required to achieve other plan objectives or policies, Council will consider: 1. how this might affect the affordability and efficient delivery of public infrastructure; 2. how this might affect the ability to provide a reasonable amount of affordable housing in the development; and 3. the potential cumulative effects of inefficient development on loss of rural land. *{Change D8}*		

Rule 15.11.5.Y

15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item		
Activity	Matters of discretion	Guidance on the assessment of resource consents

...

Y. In a **new development mapped area**: • All subdivision activities *{Change D1 & Change F2-2}*	e. Whether subdivision design supports efficient use of land *{Change D8}*	See Rule 12.X *{Change D8}*	

Notified Policy / Rule	Issue	Potential Solutions
CHANGE F2-2 **Policy 2.2.2.Y** Policy 2.2.2.Y - to be added {Change F2-2} Enable and encourage on-site low impact design stormwater management through policies and assessment rules that require stormwater management in new development mapped areas. *{Change F2-2}* **Delete Policy 2.2.5.2** **Policy 2.7.1.2.X** Ensure areas of new urban development provide for public infrastructure networks that represent the least possible long term cost to the public through: ... X policies and assessment rules that require on-site stormwater management in the **new development mapped area**. *{Change F2-2}* **Policy 9.2.1.Y** **Objective 9.2.1** Land use, development and subdivision activities maintain or enhance the efficiency and affordability of public water supply, wastewater and stormwater infrastructure. ... Policy 9.2.1.Y: Only allow subdivision activities in a **new development mapped area** where: a. an on-site stormwater management system that is designed for the whole NDMA and is installed in full or in planned stages prior to development will ensure there is no increase in the pre-development peak stormwater discharge rate from the site into the stormwater public infrastructure (at any point); or b. where this is not practicable, any adverse effects from an increase in discharge on the stormwater public infrastructure are no more than minor. *{Change F2-2}* **Policy 9.2.1.X** Policy 9.2.1.X: Require development in a **new development mapped area** that creates impermeable surfaces to be connected to the integrated communal on-site stormwater management system that meets Policy 9.2.1.Y. *{Change F2-2}*	1. Potential difficulties with NDMA being in multiple ownership – for example, if there is a reluctant or recalcitrant 2. Requirement to install infrastructure prior to obtaining subdivision consent (see Policy 9.2.1.Y and Note 9.3.7.AAA.a). The proper development process is for resource consent to be obtained prior to installation occuring so that all matters can be assessed together. Focus should be on the design of infrastructre at this stage of the consent / development process. 3. Limiting the extent of Rule 9.5.3.Z.	1. Provide a claw-back mechanism whereby when the developer of infrastructure in a NDMA with multiple owners vests that infrastructure in DCC, DCC pays that developer for the infrastructure (less the developer's pro rata share) and DCC claws-back the cost of that infrastructure vis development contributions as the other land within that NDMA comes online. AND Provide a mechanism whereby the DCC can compulsorily acquire easements in NDMA for new infrastructure. AND Delete from Rule 9.9.X.3.C the following: ', and be submitted along with the written approval of all owners of land within the **new development mapped area** unless they are the applicant/s'. 2. Delete requirement for infrastructure to be installed prior to subdivision consent. 3. Add the words 'within the subject new development

Rule 9.3.7.AA

9.3.7.AA Stormwater *{Change F2-2}*

a. In a **new development mapped area**, all development that creates an **impermeable surface** must:
   i. connect to a communal **stormwater** management system that services the **new development mapped area**; except:
      1. prior to the communal **stormwater** management system being installed, any development that creates less than 60m² of **impermeable surface** is exempt from this standard.

b. Activities that contravene this performance standard are restricted discretionary activities. *{Change F2-2}*

Note 9.3.7.AAA

Note 9.3.7.AAA - General advice and other requirements outside of the District Plan *{Change F2-2}*

a. In a new development mapped area, Policy 9.2.1.Y requires installation of a communal **stormwater** management system prior to development as part of the assessment of a **subdivision** consent. The requirements for **stormwater** management are set out in the Special Information Requirements - Rule 9.9.X. *{Change F2-2}*

b. Clause E1 - Surface Water of the New Zealand **Building** Code (**Building** Regulations 1992, Schedule 1) contains requirements regarding **buildings** and sitework in relation to managing surface water and effects on other **property**.

c. Development that will divert surface water may require resource consent under the Otago Regional Plan: Water.

d. Discharge of **stormwater** to any Otago Regional **Council** scheduled **drain** or overland flow path is managed by the Otago Regional **Council** Flood Protection Management Bylaw 2012.

e. If development affects the flow of surface water, this effect is also subject to the common law principle of natural servitude.

f. Part 4 of the Dunedin Code of **Subdivision** and Development 2010 ('Code of **Subdivision**') requires that design and **construction** of **stormwater** systems be undertaken in accordance with NZS 4404:2004 (now replaced by NZS 4404:2010), except as amended by the Code of **Subdivision**. This includes a requirement that **stormwater** systems be provided so that any new development results in an insignificant increase of runoff wherever possible (Clause 4.2.8).

g. For further information on connections to the public **stormwater** network and for assistance with design requirements for **stormwater** management systems, please contact DCC 3 Waters on 03 477 4000 at the earliest opportunity. *{Change F2-4}*

mapped area' to the end of the sentence at Rule 9.5.3.Z.a.

Rule 9.5.3.Z

9.5.3 Assessment of performance standard contraventions		
Performance standard	Matters of discretion	Guidance on the assessment of resource consents
...		
Z. In a **new development mapped area**: • Service connections - stormwater (Rule 9.3.7.AA) ***{Change F2-2}***	a. Effectiveness and efficiency of stormwater management and effects of stormwater from future development	*Relevant objectives and policies:* i. Objective 9.2.1 ii. Require development in a **new development mapped area** that creates impermeable surfaces to be connected to the integrated communal on-site stormwater management system that meets Policy 9.2.1.Y (Policy 9.2.1.X). ***{Change F2-2}*** *General assessment guidance:* iv. Council will consider how stormwater will be managed and may require a stormwater management plan to be submitted with the application (see Special Information Requirement - Rule 9.9.X). ***{Change F2-2}*** *Conditions that may be imposed include:* v. A requirement for easements, covenants, consent notices, or bonds to ensure future development will be in accordance with a stormwater management plan. vi. A requirement for on-site stormwater management, such as the installation of detention devices, in accordance with the approved stormwater management plan. ***{Change F2-2}***

Rule 9.6.2.X

9.6.2 Assessment of restricted discretionary activities		
Activity	Matters of discretion	Guidance for the assessment of resource consents
...		

X.	In a **new development mapped area**: • All subdivision activities *{Change F2-2}*	a. Effectiveness and efficiency of stormwater management and effects of stormwater from future development	*Relevant objectives and policies (in addition to those outlined in 9.6.2.2 above):* i. Objective 9.2.1. ii. Only allow subdivision activities in a **new development mapped area** where: 1. an on-site stormwater management system that is designed for the whole NDMA and is installed in full or in planned stages prior to development will ensure there is no increase in the pre-development peak stormwater discharge rate from the site into the stormwater public infrastructure (at any point); or 2. where this is not practicable, any adverse effects from an increase in discharge on the stormwater public infrastructure are no more than minor (Policy 9.2.1.Y). *{Change F2-2}*		

Special Information Requirement Rule 9.9.X

9.9.X Stormwater management plans

1. Application for subdivision in a **new development mapped area** must include a proposed stormwater management plan that demonstrates how Policy 9.2.1.Y will be achieved, unless such a plan has already been approved as part of an earlier subdivision. *{Change F2-2}*

...

3. Stormwater management plans must:
   a. be prepared by a chartered engineer or other suitably qualified person;
   b. be of a level of detail commensurate with the scale of the activity, complexity of stormwater management issues, and potential for adverse effects from stormwater; *{Change F2-2 & Change F2-3}*
   c. for a **new development mapped area** (NDMA), address the whole NDMA area, and be submitted along with the written approval of all owners of land within the **new development mapped area** unless they are the applicant/s. *{Change F2-2}*
   d. assess pre-development flows and post-development flows, generally based on the following rainfall events:
      i. for primary infrastructure, a 10% annual exceedance probability (AEP) for the critical storm duration for the NDMA and the critical storm duration and the catchment upstream of the point of discharge; and
      ii. for secondary flow paths, a 1% AEP for the critical storm duration for the NDMA and the critical storm duration for the catchment upstream of the point of discharge;
      iii. for the purposes of this requirement, 'critical storm duration' means the duration of rainfall event likely to cause the highest peak flows or water levels;

iv. for the purposes of this requirement, 'primary infrastructure' includes both open and closed conduits designed to contain the flows generated by the 10% AEP rainfall event; v. for the purposes of this requirement, 'secondary flow paths' means the flow path over which surface water will flow if the primary flow path becomes overloaded or inoperative and consists of overland flow paths with sufficient capacity to transfer the flows generated by rainfall events up to 1% AEP. Secondary flow paths should be aligned with natural flow paths and located on public land where possible. If located in private property, 1% AEP secondary flows should be through primary infrastructure unless protected by an easement; e. assess the difference between pre-development flows and post-development flows, taking into account the maximum impermeable surfaces permitted in the underlying zone and any proposed roading or accessways for the subdivision area (or in a **new development mapped area**, for the entire NDMA); f. specify the design and location of any on-site stormwater management systems to accommodate the calculated difference in flows; g. where relevant, specify the design and location of secondary flow paths; h. specify any upgrades to stormwater public infrastructure, or other infrastructure, that will be used to add capacity where it is required; i. the stormwater management system design should allow for stormwater quality treatment to reduce potential contaminants that the site and development may generate; j. areas requiring stormwater quality treatment include trafficked areas such as roads, driveways and carparks. Roof and building areas should not require stormwater quality treatment providing they are constructed with inert building products which avoid exposed metal surfaces; k. stormwater quality treatment devices shall target the removal of 75% total suspended solids (TSS) on a long-term average basis and consider the avoidance or minimisation of thermal loading effects; l. the stormwater management design should consider the use of low impact design features, for example: i. grassed/landscaped swales and other vegetation areas; ii. infiltration trenches/bioretention systems; iii. storage ponds/wetlands/sediment ponds; iv. rainwater tanks harvesting and reuse; v. rain gardens, green roofs; or vi. porous surface treatments;		

m. where low impact design features are inadequate to address stormwater discharge in a way that meets Policy 9.2.1.Y, consider the use of detention tanks;

n. for larger subdivisions, the design should incorporate consideration of how stormwater management areas can be integrated into reserves and recreation spaces;

o. for larger subdivisions, the design proposal should demonstrate how the integrity of the stormwater mitigation and management measures will not be compromised during and after subdivision (for example, avoiding premature contamination of devices during the construction of houses and ensuring that open drains that form part of the system will not be blocked or altered). ***{Change F2-2 & Change F2-3}***

Rule 15.3.4.1 Development Activity Status Table

1.	Performance standards that apply to all development activities	a. Natural Hazards Performance Standards b. Maximum building site coverage and impermeable surfaces c. Setback from scheduled tree d. **Structure plan mapped area** performance standards (where relevant)
		Y. Service connections - stormwater (in a **new development mapped area**) ***{Change F2-2}***

Rule 15.6.X

15.6.X Service Connections - Stormwater - to be added {Change F2-2}

In a **new development mapped area**, all development that creates an impermeable surface must comply with Rule 9.3.7.AA. ***{Change F2-2}***

Rule 15.10.4.Y

15.10.4 Assessment of development performance standard contraventions		
Performance standard	Matters of discretion	Guidance on the assessment of resource consents

...

Y.	In a **new development mapped area**: • Service connections - stormwater ***{Change F2-2}***	a. Effectiveness and efficiency of stormwater management and effects of stormwater from future development	See Rule 9.5. ***{Change F2-2}***

Rule 15.11.5.Y

15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item

Activity	Matters of discretion	Guidance on the assessment of resource consents
...		
Y. In a **new development mapped area**: • All subdivision activities ***{Change D1 & Change F2-2}***	f. Effectiveness and efficiency of stormwater management and effects of stormwater from future development ***{Change F2-2}***	See Rule 9.6 ***{Change F2-2}***

Notified Policy / Rule	Issue	Potential Solutions
CHANGE F3-2 **Policy 2.7.1.2.Y** Ensure areas of new urban development provide for public infrastructure networks that represent the least possible long term cost to the public through: ... Y policies and assessment rules that require wastewater detention for specified sites in the **new development mapped area** to allow urban expansion while ensuring any impacts on the **wastewater public infrastructure** network are no more than minor. ***{Change F3-2}*** **Policy 9.2.1.BB** Policy 9.2.1.BB: Require subdivision, multi-unit development or supported living facilities in specified **new development mapped areas** to provide or connect to a communal wastewater detention system that ensures that all wastewater from the future development of the entire **new development mapped area** does not exceed the capacity of the wastewater public infrastructure network. ***{Change F3-2}*** **Note 9.3.7.ZA General Advice** ... b. In **new development mapped areas** specified in Rule 9.6.2.Y, immediate connections to the wastewater public infrastructure network will not be available due to network capacity constraints. In these cases, subdivision consent may be refused even if this standard is met where an on-site communal wastewater detention system that serves 50 or more residential units is yet to be approved as a solution to capacity constraints. ***{Change F3-2}*** ... **Rule 9.6.2.Y** **9.6.2 Assessment of restricted discretionary activities** Activity | Matters of discretion | Guidance for the assessment of resource consents ...	1. Potential difficulties with NDMA being in multiple ownership – for example, if there is / are reluctant or recalcitrant owner(s) within the NDMA.	1. Provide a claw-back mechanism whereby when the developer of infrastructure in a NDMA with multiple owners vests that infrastructure in DCC, DCC pays that developer for the infrastructure (less the developer's pro rata share) and DCC claws-back the cost of that infrastructure vis development contributions as the other land within that NDMA comes online. AND Provide a mechanism whereby the DCC can compulsorily acquire easements in NDMA for new infrastructure.

Y.	In the following **new development mapped areas**, all subdivision activities, multi-unit development and supported living facilities: ***{Change F3-2}*** • Kaikorai Valley Road ***{Change IN07}*** • Selwyn Street ***{Change RTZ2}*** • Wattie Fox Lane ***{Change RTZ1}***	a. Effectiveness and efficiency of wastewater management and effects of wastewater from future development	*Relevant objectives and policies (in addition to those outlined in 9.6.2.2 and 9.6.2.X above):* i. Objective 9.2.1. ii. Require subdivision, multi-unit development or supported living facilities in specified **new development mapped areas** to provide or connect to a communal wastewater detention system that ensures that all wastewater from the future development of the entire **new development mapped area** does not exceed the capacity of the wastewater public infrastructure network (Policy 9.2.1.BB). ***{Change F3-2}*** *General assessment guidance:* iii. The identified **new development mapped areas** are serviced for wastewater but new connections to the network will not be allowed (and consequentially any multi-unit development, supported living facility or subdivision that will lead to development that will require a connection will likely be declined) until capacity constraints are resolved or a communal on-site wastewater detention system that is designed for and associated with subdivision and/or development of 50 or more residential units is integrated into the public network and vested in the DCC. After installation of the system, all activities that create wastewater will be required to connect to the system until it is no longer required. iv. In assessing the appropriateness of a proposed communal on-site wastewater detention system, Council will consider the proposed wastewater management plan submitted with the application (see Special Information Requirement - Rule 9.9.Y). ***{Change F3-2}*** *Conditions that may be imposed:* v. A requirement for the communal on-site wastewater detention system to be installed prior to certification of the survey plan pursuant to section 223 of the RMA. vi. A requirement for the communal on-site wastewater detention system to be vested in the DCC, along with a site containing it which is of a minimum 500m² in area and suitable for residential development. vii. A requirement for necessary easements and a fixed maintenance or defect period agreement to be in place prior to vesting the communal on-site wastewater detention system and associated land. ***{Change F3-2}***		

Rule 9.9.Y

9.9.Y Wastewater management plans

1. Any application for subdivision, multi-unit development or supported living facilities in a **new development mapped area** specified in Rule 9.6.2.Y must include a proposed wastewater management plan that ensures that all wastewater from the future development of the entire **new development mapped area** does not exceed the capacity of the wastewater public infrastructure network via the use of a communal wastewater detention system, unless such a system has already been approved for the site and will be connected to.
2. The wastewater management plan must be prepared by a chartered engineer and meet the following requirements:
   a. Specify the design and location of one or more communal wastewater detention systems to detain wastewater from the entire **new development mapped area**.
   b. The communal wastewater detention systems must:
      i. have the capacity to detain wastewater for a 24-hour period, prior to releasing to the wastewater via a connection to the wastewater public infrastructure network. The volume of wastewater to be detained will be calculated with reference to Part 5 of the Dunedin Code of Subdivision and Development 2010 ('Code of Subdivision');
      ii. be compatible with DCC's Supervisory Control and Data Acquisition (SCADA) system;
      iii. have a minimum 20 year expected life for all electrical / mechanical components and a minimum 50 year expected life for all civil components;
      iv. where practicable, be located such that all flow goes to one communal wastewater detention system with no pumping;
      v. have components and materials that comply with the DCC's 3-Waters Approved Product and Manufacturers List and Part 5 of the Dunedin Code of Subdivision and Development 2010 ('Code of Subdivision').
3. The wastewater management plan must be submitted along with the written approval of all landowners within the **new development mapped area** unless they are the applicant/s. ***(Change F3-2)***

Rule 15.10.4.Y

15.10.4 Assessment of development performance standard contraventions			
Performance standard	Matters of discretion	Guidance on the assessment of resource consents	
...			
10. Maximum building site coverage and impermeable surfaces	c. Effects on efficiency and affordability of infrastructure (stormwater) ***{Change F2-3}***	See Rule 9.5.	
	d. Effects of stormwater from future development ***{Change F2-3}***		

Rule 15.11.5.Z

15.11.5 Assessment of restricted discretionary activities in an overlay zone, mapped area, heritage precinct or affecting a scheduled heritage item		
Activity	Matters of discretion	Guidance on the assessment of resource consents
...		
Z. In the following **new development mapped areas**, all subdivision activities, multi-unit development, and supported living facilities: ***{Change F3-2}*** • Kaikorai Valley Road ***{Change IN07}*** • Selwyn Street ***{Change RTZ2}*** • Wattie Fox Lane ***{Change RTZ1}***	a. Effectiveness and efficiency of wastewater management and effects of wastewater from future development ***{Change F3-2}***	See Rule 9.6 ***{Change F3-2}***

Notified Policy / Rule

CHANGE F2-6

Policy 9.2.1.AA

Policy 9.2.1.AA	Only allow subdivision in a **new development mapped area** where any new public or private 3-waters infrastructure is designed to connect to, and provide capacity for, future urban development on adjoining or nearby sites that are zoned for urban development, where necessary. ***{Change F2-6}***

Rule 9.5.3.Z

9.5.3 Assessment of performance standard contraventions		
Performance standard	Matters of discretion	Guidance on the assessment of resource consents
Z. In a **new development mapped area**: • Service connections - stormwater (Rule 9.3.7.AA) ***{Change F2-2}***	a. Effectiveness and efficiency of stormwater management and effects of stormwater from future development	iii. Only allow subdivision in a **new development mapped area** where any new public or private 3-waters infrastructure is designed to connect to, and provide capacity for, future urban development on adjoining or nearby sites that are zoned for urban development, where necessary (Policy 9.2.1.AA). ***{Change F2-6}***

Rule 9.6.2.X

9.6.2 Assessment of restricted discretionary activities		
Activity	Matters of discretion	Guidance for the assessment of resource consents
...		
X. In a **new development mapped area**: • All subdivision activities ***{Change F2-2}***	a. Effectiveness and efficiency of stormwater management and effects of stormwater from future development	iii. Only allow subdivision in a **new development mapped area** where any new public or private 3-waters infrastructure is designed to connect to, and provide capacity for, future urban development on adjoining or nearby sites that are zoned for urban development, where necessary (Policy 9.2.1.AA). ***{Change F2-6}***

Issue

Limit the extent of Policy 9.2.1.AA and related lower order provisions to provision of capacity of infrastructure within the specific new development mapped area.

Potential Solutions

Delete the words 'on adjoining or nearby sites that are zoned for urban development' and insert the words 'within the subject new development mapped area' before 'where necessary'.

AND

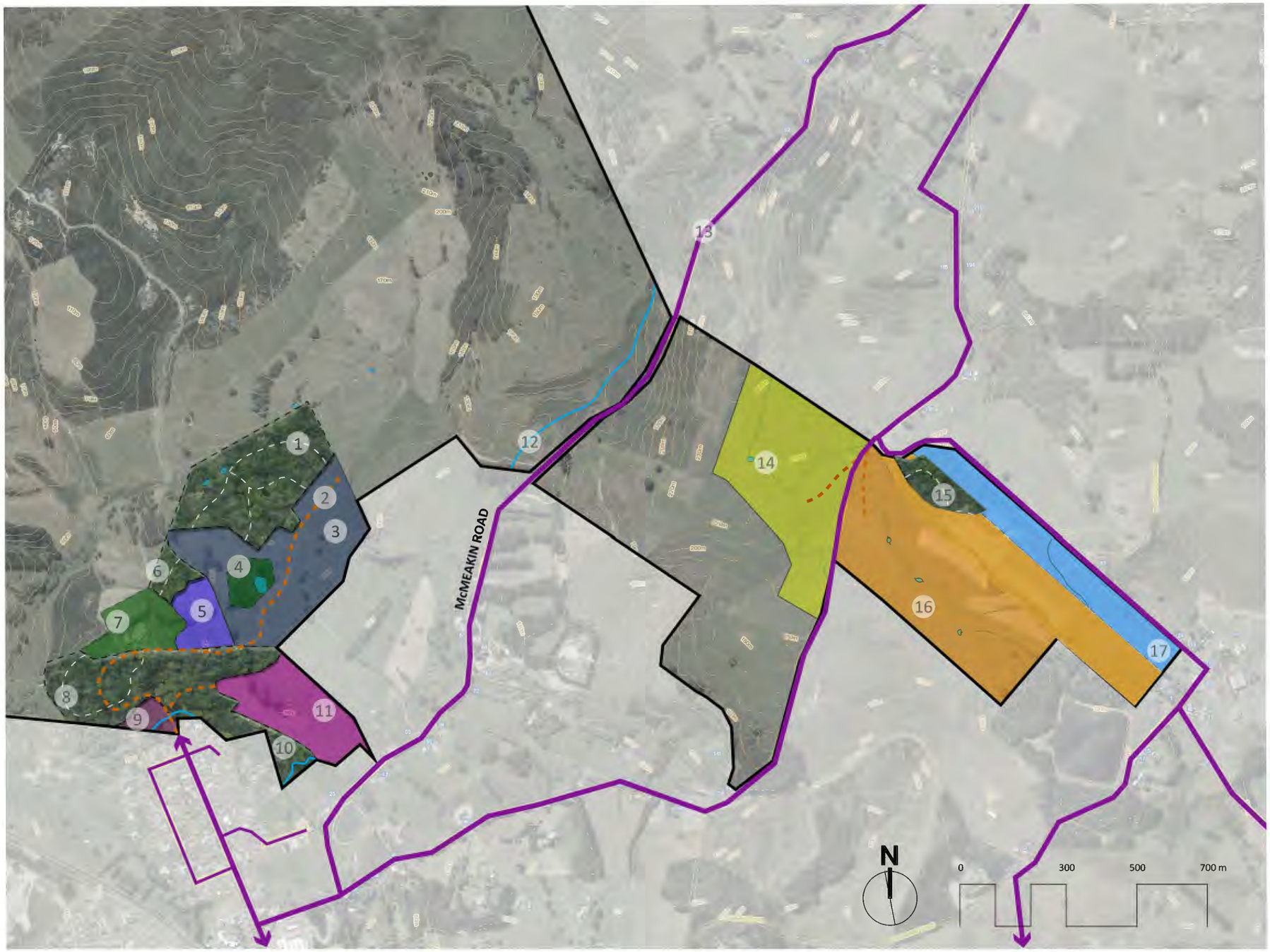
Similarly in Rule 9.5.3.Z.a.iii delete the words 'on adjoining or nearby sites that are zoned for urban development' and insert the words 'within the subject new development mapped area' before 'where necessary'.

AND

Similarly in Rule 9.6.2.X.a.iii delete the words 'on adjoining or nearby sites that are zoned for urban development' and insert the words 'within the subject new development mapped area' before 'where necessary'.

KEY

1. Native revegetated hill side and gully with potential walkways - approx 10.3ha
2. New site access
3. Low Density Residential - 700m² - 1000m² lots
   Approximately 13.3ha, subject to survey
   Potential yield: 133 - 93 lots
4. Open parkland area around existing dam
5. General residential 1 - 450m² - 750m² lots
   Approximately 2.4ha, subject to survey
   Potential yield: 37 - 22 lots
6. Native revegetated area with potential walkway - approx 1.3ha, subject to survey
7. Recreation and park area - approx 3.4ha, subject to survey
8. Opportunity for walkways in revegetated areas
9. Parkland - enhance entranceway with additional specimen trees, approx 1ha, subject to survey
10. Extend existing vegetation with native species to soften appearance of proposed housing, approx 12ha, subject to survey (including existing plants)
11. Low Density Residential 1 - 750m² - 1000m² lots
    Approx. 6.3ha, subject to survey
    Potential yield: 59 - 44 lots
12. Abbotsford Creek
13. Roading
14. General Residential 1 and / or / Low Density Residential - 400m² - 900m² lots - approx. 15.6.ha, subject to survey.
    Potential yield - 273 - 121 lots
15. Native revegetation with potential walkways
    Approx. 2.ha, subject to survey
16. General Residential 1 and / or / Low Density Residential - 400m² - 900m² lots - approx. 26.7ha, subject to survey.
    Potential yield - 467 - 207 lots
17. Pylons/National Grid Corridor (DCC District Plan)



site. ENVIRONMENTAL CONSULTANTS

HUDSON ASSOCIATES LANDSCAPE ARCHITECTS

188 NORTH TAIERI ROAD

DATE: 03-03-21 SCALE @A1: 1:6000
DWG: 002 REVISION #: A

LANDSCAPE PROPOSAL

GeoSolve Ref: 210116
2 March 2021

Wendy Campbell
188 North Taieri Road
Abbotsford
Dunedin 9018

Preliminary Geotechnical Assessment
188 North Taieri Road, Abbotsford, Dunedin

Dear Wendy,

In accordance with our Agreement dated 22 February 2021 we have undertaken a preliminary engineering geological appraisal of the above property. Our appraisal has comprised a site inspection and desktop review of existing information, relating mainly to natural hazards and coal mining hazard.

Potential Development

We understand that you are seeking to re-zone two areas of the above property from their existing rural land use to residential land use, i.e.

- Area 1 is under consideration for potential rezoning to General Residential 1 land use (minimum lot size 500m^2).
- Area 2 is under consideration for potential rezoning to Large Lot Residential 1 or Large Lot Residential 2 land use (minimum lot size 2,000m^2 and 3,500 m^2 respectively).

We understand that the potential rezoning has already been considered by Dunedin City Council (DCC) for inclusion in notification of Variation 2 of the 2GP, however we understand that the property was not shortlisted for notification based on concerns about natural hazards on the property.

The existing property comprises approximately 511 ha of rural land (Rural Industry: Stock Finishing). The property appears to have a long history of rural and industrial land use including coal mining, sand/clay quarrying, farming and is currently used as a farm. The land is generally gently to moderately-sloping with localised steep areas.

This report summarises a desktop review of readily available Council hazard mapping and a preliminary site inspection by an engineering geologist. Not all areas of the property have been mapped or assessed and the intent at this stage is to provide broad comment on any potential constraints to residential land use from the geotechnical viewpoint, based on general visual observations and preliminary interpretation only.

Areas 1 and 2 are shown in Figures A & B below and in Figures 1 and 2 (appended). We have defined areas that are unlikely to be suitable for residential land use (shown in grey) and areas that are possibly suitable for residential land use (shown in blue and subject to further detailed checks). All other areas appear to be relatively straightforward for residential development.

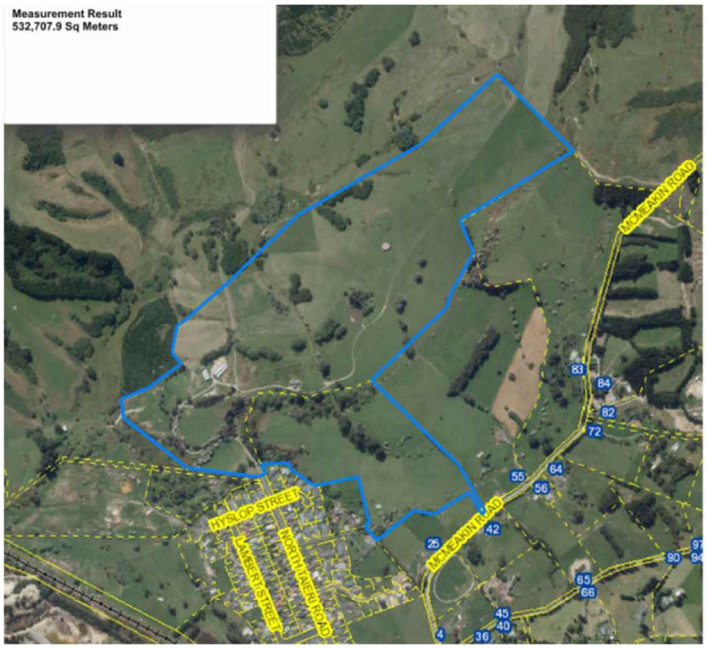


Figure A – Location of Area 1

Figure B – Location of Area 2

Geological Setting

The geology of the Dunedin area is dominated by volcanic rock types of basaltic to andesitic composition that were intruded through pre-existing marine sediments during Miocene times. Extensive volcanism at that time produced lava flows and bedded volcanoclastic materials were widely distributed by eruptions. The generalised stratigraphic profile comprises schist at depth, overlain by a Cretaceous to Tertiary-age sequence; initially by thin non-marine sediments and then a thick accumulation of marine sediments including sandstones and mudstones. The volcanic rock types cross-cut these sediments where vents were present and extensively mantle them where lava flows or volcanic ejecta were deposited.

Area 1 is shown on published geological maps to be underlain predominantly by two rock types, the Taratu Formation and the Abbotsford Formation. The approximate mapped extents of these rock types is shown on Figure 1 appended. The Taratu Formation is a coal-bearing terrestrial sedimentary rock type and the Abbotsford Formation is a fine-grained marine siltstone.

Area 2 is shown on published geological maps to be underlain predominantly by three rock types, the Caversham Sandstone, Burnside Mudstone and the Dunedin Volcanic Group.

Overburden soils are likely to be a combination of colluvium, loess and possibly ancient landslide debris. Some relatively deep railway cuttings in Area 1 expose colluvium or debris with boulders of volcanic rock, suggesting relatively deep colluvium at least locally.

Two minor faults are mapped on Area 1, however these have not been mapped as active faults by GNS Science Ltd.

Landslide Hazard

The property generally contains numerous recognised landslides (mapped by GNS Science Ltd), however Areas 1 and 2 are notable for being largely free of landslides, with only small areas of mapped landslide, as follows:

Area 1 coincides with three landslides, referred to here as Landslides A, B & C.

Area 2 coincides with two landslides, referred to here as Landslides D & E.

- Landslide A (contained within Area 1) is located near a dammed pond and an area where trees have been planted to assist with slope stability. GNS Science Ltd has mapped this as likely certainty, probably prehistoric with unknown activity, unknown last movement and low sensitivity. A note indicates that a dam has been constructed across landslide debris.
- Landslide B (contained within Area 1) is located towards the north-east extents of Area 1 and is mapped as definite certainty, probably prehistoric with unknown activity, unknown last movement and low sensitivity.
- Landslide C (contained within Area 1) is a small area of the lateral scarp region of a much larger landslide that lies to the north of Area 1. This is mapped as likely certainty, prehistoric with unknown activity, unknown last movement and low sensitivity.

- Landslide D (contained within Area 2) affects Mt Grand Road and also neighbouring property, partly coinciding with Area 2. This is mapped as possible certainty, prehistoric, with unknown activity, unknown last movement and low sensitivity. Visual inspection confirms upslope scarps, downslope debris with ponds and tree plantings, as well as some cracking damage to the surface of Mt Grand Road. This may indicate that the landslide is periodically active, however it occupies only a small part of Area 2.
- Landslide E (contained within Area 2) is a large landslide feature, with the head area coinciding with the western corner of Area 2. The landslide is likely to be formed within Burnside Mudstone, a rock type which is known to host several other major landslides in the Dunedin area. This landslide is mapped as definite certainty, prehistoric with unknown activity, unknown last movement and medium sensitivity.

We do not recommend residential development over the above areas of mapped landslide and a sufficient setback should be nominated (based on detailed subsurface investigations). Provisional setbacks are indicated on Figures 1 and 2 for the purposes of preliminary planning but these may be overly conservative (subject to confirmation by subsurface investigations). Development within these areas may be possible in the future, but would require extensive geotechnical investigations, slope stability analysis and possibly stabilisation works (e.g. deep drainage, significant earthworks).

Part of Area 2 coincides with Burnside Mudstone which is well known for being susceptible to major landslide activity in some settings. Landslide E appears to be hosted by this rock type and care will be required if residential activity is to be established over this rock type. We recommend confirmatory subsurface investigations to more fully evaluate the extents and characteristics of the Burnside Mudstone over the area shown in blue on Figure 2.

Area 2 also contains a geological contact that is well known in the Dunedin area as a source of spring flow and possible triggering of landslide activity, i.e. the contact between low permeability Caversham Sandstone and overlying fractured volcanic rock. Rainwater infiltration through the fractures within the volcanic rock can lead to a perched groundwater table forming on the much less permeable upper surface of the Caversham Sandstone and spring flows often emerge where the stratigraphic contact daylights with the ground surface. We noted extensive areas of wet surficial soils along part of the Abbotts Hill Rd walking track and some areas of clear spring flow defined by growth of sedges etc. Landslide D coincides with this stratigraphic contact and is likely to have been triggered by soil saturation resulting from these types of spring flows. An important design consideration for subdivision in this setting will be to ensure that adequate drainage is in place to prevent saturation of proposed residential subgrades. This can usually be accomplished by capturing and diverting the groundwater flows using deep subsoil cut-off drains.

In general the areas underlain by Dunedin Volcanic Group and Caversham Sandstone are likely to be straightforward for residential development (subject to test pitting investigations) and we note that very few landslides are developed over these rock types on site, with the exception of Landslide D where adverse groundwater conditions are likely at the contact zone only, as discussed above. The areas of the site underlain by Abbotsford Formation and Burnside Mudstone could potentially be more susceptible to slope

instability, however we note that most areas of this rock type are on relatively gentle slopes with no apparent indicators of increased vulnerability to landsliding. Large areas of residential activity have already been successfully established on these rock types (e.g. in Abbotsford and Green Island). The Taratu Formation is only mapped over the western extents of Area 1, however as discussed below, this area coincides with underground coal workings and for that reason is unlikely to be suitable for residential land use. The above rock types are likely to be overlain by variable overburden soils that may comprise colluvium, slopewash, loess and some localised ancient landslide debris.

Further investigation of landslide hazard will be required for any subdivision within Areas 1 and 2, however it is notable that the landslide areas are limited in extent and unlikely to widely influence the majority of Areas 1 and 2. Test pitting and trenching is likely to be suitable for further investigations, however some drilling may be required locally.

In addition, the north-eastern extents of Area 1 includes an area of land that is in close proximity to landslides and should be investigated further to ensure that it is suitable for residential use (eastern-most blue are on Figure 1). It should be noted that the exact location of the landslides and any setbacks required should be determined by detailed geotechnical investigations at the subdivision consent stage.

Coal Mine Hazard

The property is not shown on the DCC 2GP mapping as lying within any formally defined land stability hazard zone with respect to historic coal mining activity, however general hazard maps provided by DCC show that underground coal mining has previously occurred on a minor area of the property. Compilation of historical mine records and mapping by DSIR (A.R. Mutch 1982) has defined an area of mine workings within Area 1, as shown on Figure C below and Figure 1 (appended). This includes annotation of features such as adits and shafts. Isopach mapping indicates that the main worked coal seam was up to 4 m thick, however there are no obvious data regarding the depth of the workings in this area. Detailed mine maps held by the landowner have been supplied which show that significant underground workings are likely to be present, however geo-referencing has not been carried out at this stage. There is a note that some entrances may lie outside the areas defined.

Areas known to be underlain by underground mine workings can present a hazard of surface subsidence resulting from collapse of voids at depth and crown holes that can propagate to the surface. Collapse of mined voids in such situations could occur under static conditions (e.g. from decay of props and roof support capping timbers) however the risk will likely be greater during earthquake. Any structures could therefore be at risk of damage in this setting and safety concerns could apply if voids are present. It is possible that most mine workings have already collapsed as the mining began in the late 1800s and significant decay of timber supports could be expected since that time. Areas of collapse are often evident as depressions at surface and the soils under these areas can be disturbed by bulking.

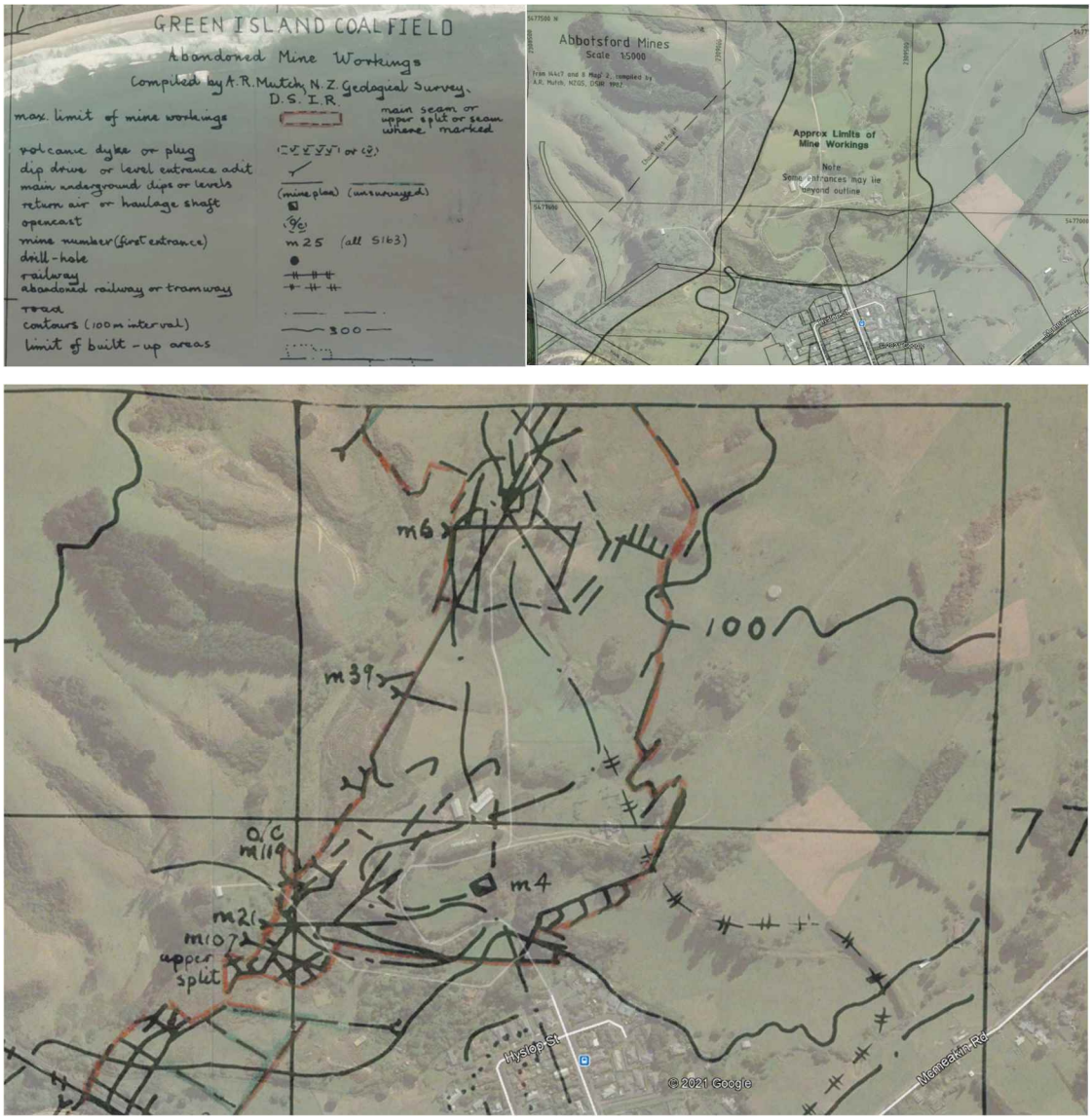


Figure C – Compilation of historical coal mine records by DSIR, 1982 over part of Area 1 including farm sheds and existing dwelling.

Council are likely to be reluctant to grant consent for close residential subdivision in an area where an undefined coal mine subsidence risk has been identified. For unrestricted development without specific foundation design requirements, detailed site drilling would need to be carried out to identify an absence of voids and confirm that unsuitable bulked soils in loose condition are not present. This is unlikely to be fully successful and would in any case be very costly. It may be possible to obtain and research full historical records of the mining activity, however this may not enable reduction of the area currently considered to be underlain by workings. It may however enable the eastern extents of the mined area to be understood in greater detail with definition of a safe building area.

The eastern extents are expected to be deepest and the coal bearing rock type (Taratu Formation) is overlain by Abbotsford Mudstone in this area. Precedent performance appears positive as no subsidence features were noted here. This deeper mined area appears to have no evidence of previous crown hole collapse features based on review of existing and early (1942 and 1947) aerial photography. In addition, the existing dwelling lies within the hazard zone and hence residential activity has previously been considered possible within the overall mined area.

It may therefore be possible to demonstrate that overburden thickness above the coal seam is sufficiently thick to mitigate the potential for crown hole collapses reaching the surface. Crown-hole subsidence is most likely to occur in areas where the coal to overburden thickness ratio is less than 1:10. Based on preliminary assessment of topography and the average dip angle of regional sedimentary bedding, the eastern-most extents of the mined area may be up to 100 m deep assuming that the seam was followed from surface. Assuming a coal seam thickness of 4 m, it is likely that the coal to overburden thickness ratio will be less than 1:10 over much of the coal mine hazard zone and hence high potential for crown hole collapse features at surface is only likely to apply to part of the site. These areas are possibly suitable for residential land use and are provisionally shown on Figure 1 (western blue area), however detailed research of coal mine records, further analysis, cross section preparation and some drilling investigations will be required to fully confirm suitability within this area.

We can provide further detailed investigations and analysis if the area of coal mining is to be considered for residential use.

Liquefaction Hazard

The site has been mapped in a 2014 liquefaction hazard assessment[1] as belonging to Domain A, which is predominantly underlain by rock or firm sediments; in this domain there is little or no likelihood of damaging liquefaction occurring.

Consequently, no liquefaction hazard is expected to apply to Areas 1 and 2, however full confirmation generally requires some subsurface investigation

Active Fault Hazard

Dunedin has traditionally been considered to have lower than average seismic activity when compared to other areas in New Zealand, however nearby active faults are known and strong shaking is certain to occur periodically.

Cook et al[2] states that the earthquake hazard in Dunedin is dominated by relatively infrequent moderate to large earthquakes (magnitude up to M_w 7.5) in eastern Otago, and

[1] Barrell, D.J.A., Glassey, P.J., Cox, S.C., Smith Lyttle, B. (2014). Assessment of liquefaction hazards in the Dunedin City district. GNS Science Consultancy Report 2014/068. 68p.

[2] Cook, DRL, McCahon, IF and Yetton, MD (1993). The Earthquake Hazard in Dunedin. Study funded by EQC, Research Project 91/56.

large to very large earthquakes in the much more seismically active Fiordland and Westland regions.

The nearest active faults with demonstrated Late Quaternary movement history are the Green Island Fault and the Akatore Fault. The Green Island Fault is currently considered to be the cause of the 1974 earthquake that caused damage in Dunedin. It is mapped approximately 7 km to the south of the subject site.

Several faults have been recorded on the ORC Natural Hazards Database as potentially relevant to the subject site, i.e. the Dunstan North Fault, Dunstan South Fault, Alpine Fault and Akatore Fault.

The Dunstan Faults are distant from Dunedin and not expected to constrain residential development at this site.

The Akatore Fault is likely to be capable of generating magnitude 7.5 earthquakes in Dunedin. Published small-scale geological mapping indicates the Akatore Fault is at least 2.5 km to the south of the subject site and hence ground rupture damage is not relevant to this site. The Akatore Fault is indicated as 'active', with results from the latest investigations by GNS Science indicating at least part of the fault last ruptured 742 to 973 years ago. Its mapped (active) fault trace is truncated 11 km southwest of the site and its location at that point is concealed. Its continuation (mapped as inactive) passes approximately 50 m north of the subject site. A recent paleoseismic study of the Akatore fault found that three recent ruptures of this fault occurring in the past 15,000 years (two of which occurred in the past 1,300 years) were preceded by a minimum 110,000 year period of quiescence, suggesting this fault exhibits strong aperiodicity of earthquake occurrence. The authors suggest it is prudent to assume that the relatively high rates of recent fault activity will continue, with an estimated recurrence interval of 450-5110 years.

Other known faults that have some potential to cause strong shaking in Dunedin are the Titri Fault and the North Taieri Fault, located roughly 1.5 km and 7 km northwest of the site, respectively.

Strong ground shaking throughout the South Island is likely to be associated with a rupture of the Alpine Fault, located along the West Coast of South Island. There is a high probability an earthquake with an expected magnitude of over 7.5 will occur along the Alpine Fault within the next 50 years.

Average return periods for shaking intensity are: MM 7 = 100 years, MM 8 = 450 years and MM 9 = >2,500 years. The most recent major earthquake to affect Dunedin occurred in 1974 and produced damage consistent with MM 7 intensity.

A risk of seismic activity has been identified for the region as a whole and appropriate allowance should be made for seismic loading during detailed design of the proposed development, but there are no site-specific constraints.

Flood Hazard

Flood hazard assessment is beyond the scope of this report, however we note from the ORC Natural Hazards Database, that there may be some minor flood hazard associated with the lowest lying area of the site, shown in Figure D. A hydrologist can advise further on any mitigation required, however simple adoption of minimum floor levels may be appropriate if required.

Figure D – Potential area of flood hazard.

Previous Land Use Considerations

We have not carried out a full review of historical land use or LIM reports etc, however we note that parts of the property have been used for various industrial and extractive industry land use.

As described above, part of Area 1 has been utilised for coal mining and a sand quarry was also located elsewhere on the property. A railway line has operated on the property for the purposes of coal and sand extraction. The remains of the railway are visible as a series of cuttings and embankments that cross part of Area 1. Some remnants of sand processing structures are also visible within Area 1. It is likely that some fill has been placed locally as part of these activities and some minor localised slope instability is associated with these fills. These industrial activities are of unknown scale, however, appear to be largely contained within the area underlain by former coal mines.

Area 2 does not appear to have been used for major industrial activity, however we understand from the landowner that a former owner carried out trenching for the purposes of waste burial from freezing works industry. The full extent of the trenching/burial is not confirmed, however these trenches are clearly visible over parts of Area 2 (see Figure 2 appended). The areas indicated on Figure 2 may need earthworks treatment or specific foundation design for residential use.

A water race has also been noted within Area 1.

Consequently, previous land use may result in some localised geotechnical considerations for subdivision design and these can be advised in greater detail following detailed subsurface investigations at the subdivision planning stage.

Summary of Geotechnical Considerations for Residential Land Use

- We recommend that at least part of the area underlain by former coal workings should be excluded from residential land use as there is a risk of surface subsidence and bulked soils over parts of Area 1. This area is shown provisionally on Figure 1, based on existing hazard mapping, however further research into the mining history may enable refining of the boundary of the workings. It may also be possible that areas of the deepest workings (shown in blue on Figure 1) could potentially be suitable for residential land use, as discussed above. However, further research and investigations will be required to confirm suitable areas. We can provide further detailed investigations and analysis if the area of known coal mining is to be considered further for residential use.
- The areas of the five landslides described above should also be provisionally excluded from residential land use, with adequate setbacks defined. Other minor areas may also be susceptible to slope instability. Such areas are likely to be relatively limited areas but could include steep slopes, fill slopes and setback areas at the toe and crest of the known landslides. These details can be advised further during standard geotechnical investigations at the subdivision stage, when conceptual scheme plans are available. Development within these areas may be possible in the future, but would require extensive geotechnical investigations, slope stability analysis and possibly stabilisation works (e.g. deep drainage, significant earthworks).
- Further research will be required to determine the full extent of soil disturbance from trenching and freezing works offal burial activities within Area 2. The areas of the most obvious trenches indicate that considerable settlement of the backfill has occurred and that the trenches are likely to be underlain by soft uncontrolled fill and organic soil types. Such soils are unsuitable for standard foundations, however if trenching depths are relatively shallow, then it may be possible to remediate the areas with earthworks (cut and fill). Piling of structures may also be possible, however the trenched areas are likely to be prone to ongoing differential settlement which would be generally disruptive to pavements and yard areas. Further investigations will be required to advise on options.
- Groundwater control is likely to be necessary for parts of the site, particularly Area 2 where there is a geological contact between Caversham Sandstone and overlying fractured volcanic rock as discussed above. An important design consideration for subdivision in this setting will be to ensure that adequate drainage is in place to prevent saturation of proposed downslope residential subgrades. This can usually

be accomplished by capturing and diverting the groundwater flows using simple deep subsoil cut-off drains, perhaps directed to existing watercourses.

- Figures 1 and 2 and the discussion above indicates that much of the area being considered for rezone is likely to be appropriate for residential land use. The areas of landslides and former coal mines will likely need to be specifically excluded from residential use (unless demonstrated to be suitable) or otherwise utilised for other purposes such as reserves.
- Standard subsurface investigations will be required to confirm geotechnical requirements for any subdivision and residential land use within Areas 1 and 2. Specific objectives of these investigations will include investigations to determine appropriate setbacks, further checks to confirm limitations related to coal mines, characterisation of the Burnside Mudstone, determination of the extent of trenching in Area 2 and investigation of groundwater conditions in Area 2.
- Further investigation of landslide hazard will be required for any subdivision within Areas 1 and 2, however it is notable that the landslide areas are limited in extent and unlikely to widely influence the majority of Areas 1 and 2. Test pitting and trenching is likely to be suitable for further investigations, however some drilling may be required locally. Geometric design of any future subdivision earthworks should be carried out by a land development specialist with consideration of existing watercourses.
- Soil contamination inputs are beyond the scope of this report, however industries such as coal mining, quarrying and burial of waste can result in contamination which could be further assessed by environmental engineer.
- We note that there are major Council-owned water services pipes on the property as well as a concrete reservoir. We assume that these can be adequately managed via appropriate easements. Care will be required to ensure that potential leakage from buried pipes is adequately managed to prevent soil saturation and potential instability.

Applicability

This report has been prepared for the benefit of Wendy Campbell with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

We have not carried out any subsurface investigations at this early stage. This report is intended to provide preliminary comment on likely geotechnical issues at the rezoning application phase only.

Yours faithfully,

Mark Walrond
Senior Engineering Geologist

Reviewed for GeoSolve by: Colin Macdiarmid, Senior Geotechnical Engineer

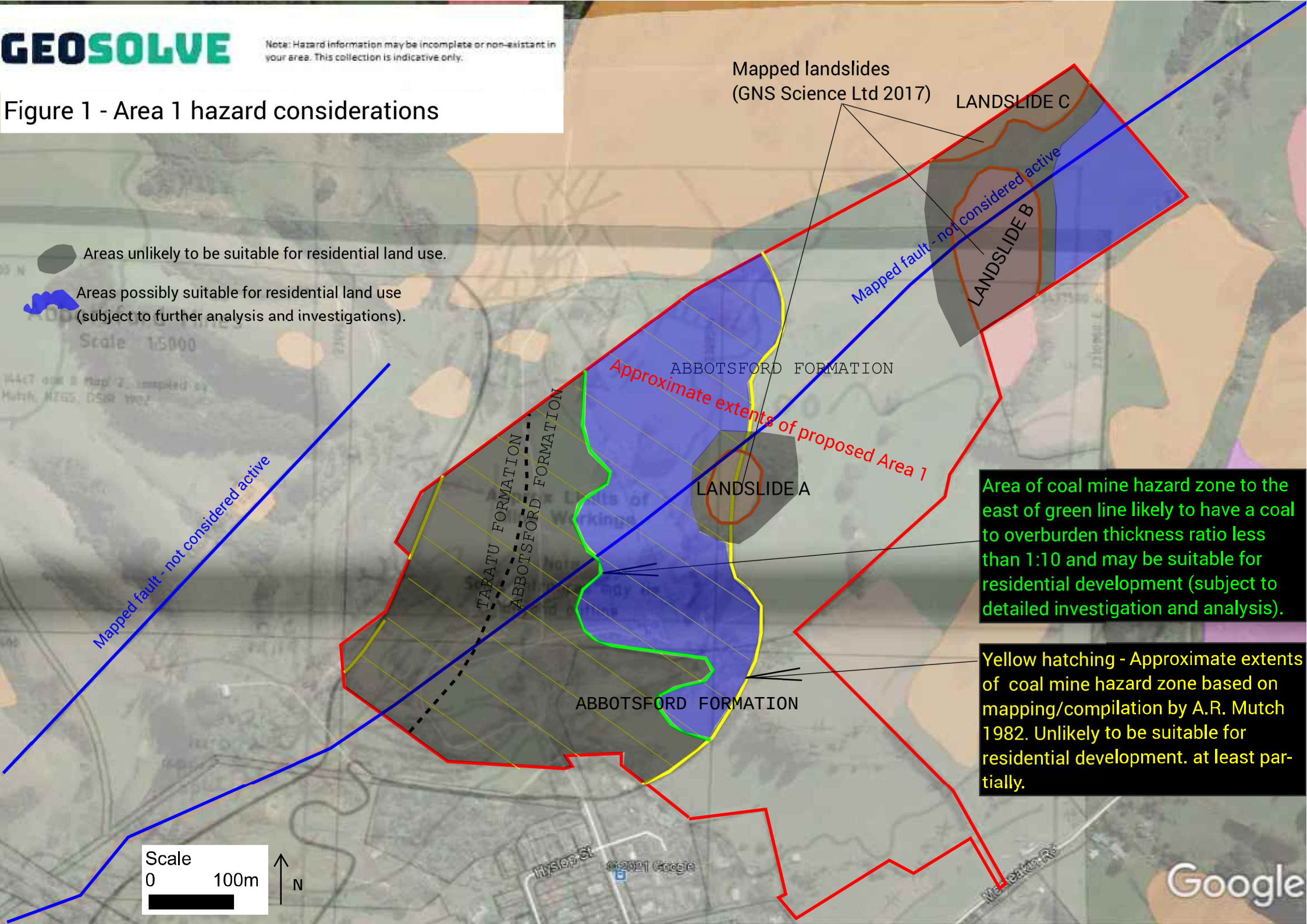
GeoSolve Limited

Appended: Figures 1 and 2

GEOSOLVE

Note: Hazard information may be incomplete or non-existant in your area. This collection is indicative only.

Figure 1 - Area 1 hazard considerations



GEOSOLVE 7/2009

Note: Hazard information may be incomplete or non-existant in your area. This collection is indicative only.

Figure 2 - Area 2 hazard considerations