LAND CAPABILITY ASSESSMENT

737 Berrebangelo Road
YASS RIVER NSW
Lot 103 DP 1298436

3 April 2024 (V01)

FRANKLIN CONSULTING AUSTRALIA PTY LTD
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Limitations:

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SUMMARY

The proposed development is a 2-lot subdivision at 737 Berrebangelo Road, Yass River.

Lot 201 A new lot of 26 ha with Building Envelope

Lot 202 A new lot of 54 ha, with Building Envelope

There are adequate areas within the Building Envelopes for on-site disposal of effluent and dwelling construction, see below and the summary table for specific comments.

Water supplies

Potable water supply for new lots will be through capture and storage of roof water in potable water tanks. The lots will dispose of domestic effluent on-site.

Constraints Assessment

The land capability assessment is designed to determine the suitability of the proposed subdivision to support new lots based on the capacity of the lots to sustainably manage effluent on-site, as per Council requirements and Australian Standards. The suitability and constraints for dwelling construction are also considered in this assessment.

Constraints to on-site effluent management and dwelling construction have been assessed in accordance with:

- assessment of on-site effluent capability, based on Appendix C of ANZ Standard 1547:2012, *Site and Soil Evaluation for Planning, Rezoning and Subdivision of Land* and also the NSW guideline*, The Silver Book*;
- assessment of land capability for dwellings is based on excluding land which is greater than 15% slope, seasonally waterlogged, salt effected or within riparian corridor buffers.

Key Effluent Constraints

The building envelopes on both proposed lots have limited soil depth making the sites unsuited to effluent disposal via subsoil absorption. The other major constraints to on-site effluent disposal are the buffer distances required from the numerous minor drainage depressions and dams, areas of erosion and seasonal waterlogging.

It is considered there is an adequate area of suitable site and soil conditions located within the proposed Building Envelopes to enable the on-site disposal of effluent generated by future dwelling(s).

This is based on an unconstrained effluent disposal area of >1,500m^2 being available on both lots. This area is adequate to support surface spray which is suited to the shallow soils which exist across the building envelopes on Lots 201 and 202.

Key Constraints to Dwelling Construction

The major constraints to the construction of dwellings on the site are the riparian corridors required from the 1st and 4th Order Streams and the areas of erosion and seasonal waterlogging. The proposed Building Envelopes have an adequate area of land which is unconstrained for dwelling construction.

Recommended effluent management systems

Effluent treatment on the two proposed lots should be **secondary treatment systems (Aerated Wastewater Treatment Systems) which include disinfection**. High quality secondary treated and disinfected effluent will minimise potential impacts to the surface water drainage network on the site which drains to join Hickeys Creek on the western boundary of the property.

Secondary treated effluent should be dispersed through surface irrigation on Lots 201 & 202 due to the limited soil depth on these sites.

New lots should provide an On Site Sewage Management Report (OSSM) which is specific to the final design of the dwelling and associated infrastructure, and consistent with the recommendations contained in this report.

Primary treatment of effluent is not considered suitable for the site due to limited soil depth.

REPORT SCOPE AND TECHNICAL REFERENCES

The report incorporates the results of an assessment of land capability for the new dwelling lots. The development proposal involves 2 new dwelling entitlements and associated infrastructure.

This assessment looks at the capability of the site to support the proposed development including:

- **Assessment of land capability for on-site effluent management,** based on Appendix C of ANZ Standard 1547:2012, *Site and Soil Evaluation for Planning, Rezoning and Subdivision of Land* and *The Silver Book*;
- **Assessment of land capability for dwelling construction,** based on excluding land within riparian buffer zones, areas of gully erosion or steep land; and
- **General land management recommendations** for constrained and sensitive areas. These will include effluent disposal areas, steep slopes, riparian zones, poorly drained waterlogged soils and areas of native vegetation. Recommendations will be general in nature and are designed to assist in determining appropriate land management practices for different parts of the site.

The report also refers to, or relies on, standards and technical references listed below.

- *On-site Sewage Management for Single Households* (The Silver Book) NSW Govt, 1998.
- *ANZ Standard 1547:2012 On-site Domestic Wastewater Management*
- *Soil Landscapes of the Goulburn 1:250,000 Sheet*. Hird,C. (1991) Soil Conservation Service of NSW
- *Soil Landscapes of the Canberra 1:100,000 Sheet*. Jenkins, B.R. (2000) Department of Land and Water Conservation
- *Yass Valley Local Environmental Plan (2013)*

LOCATION AND DEVELOPMENT INFORMATION

Address: 737 Berrebangelo Road, Yass River, NSW

LGA: Yass Valley Council

Owner/Developer: C/- Rachel Doberer, DPS Yass.

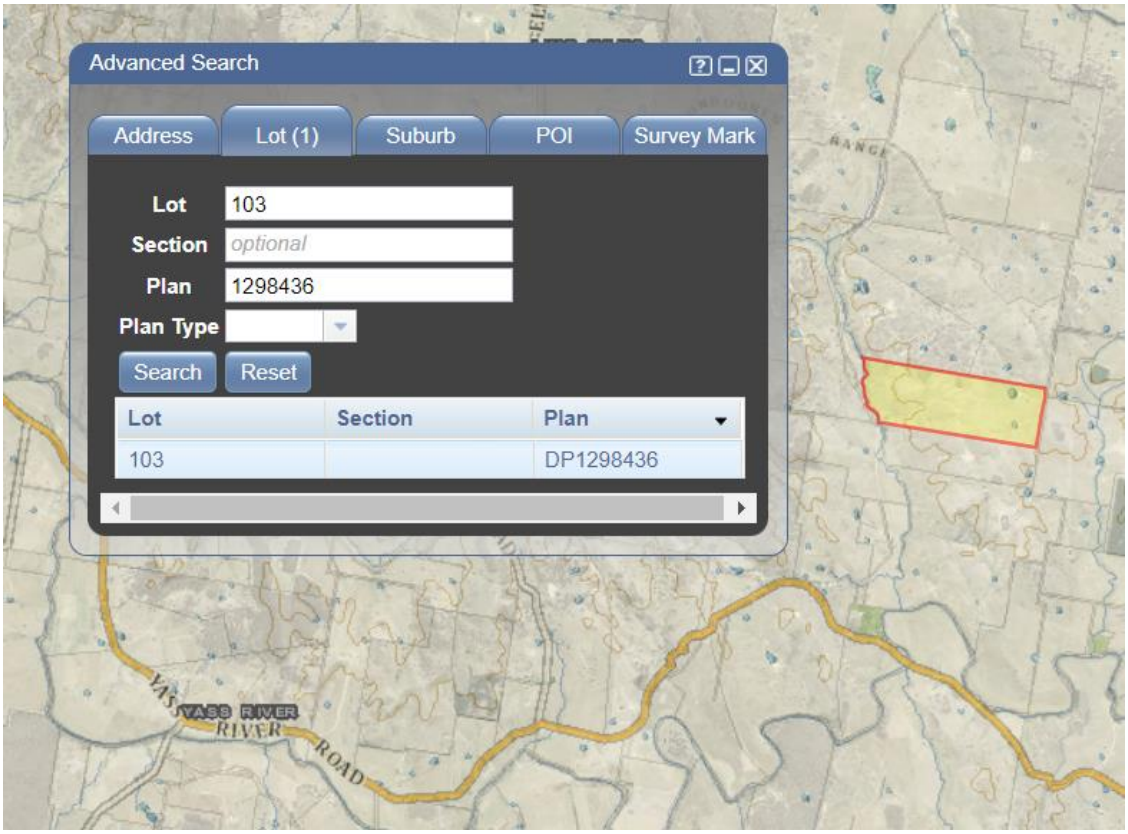

Figure 1: Regional location

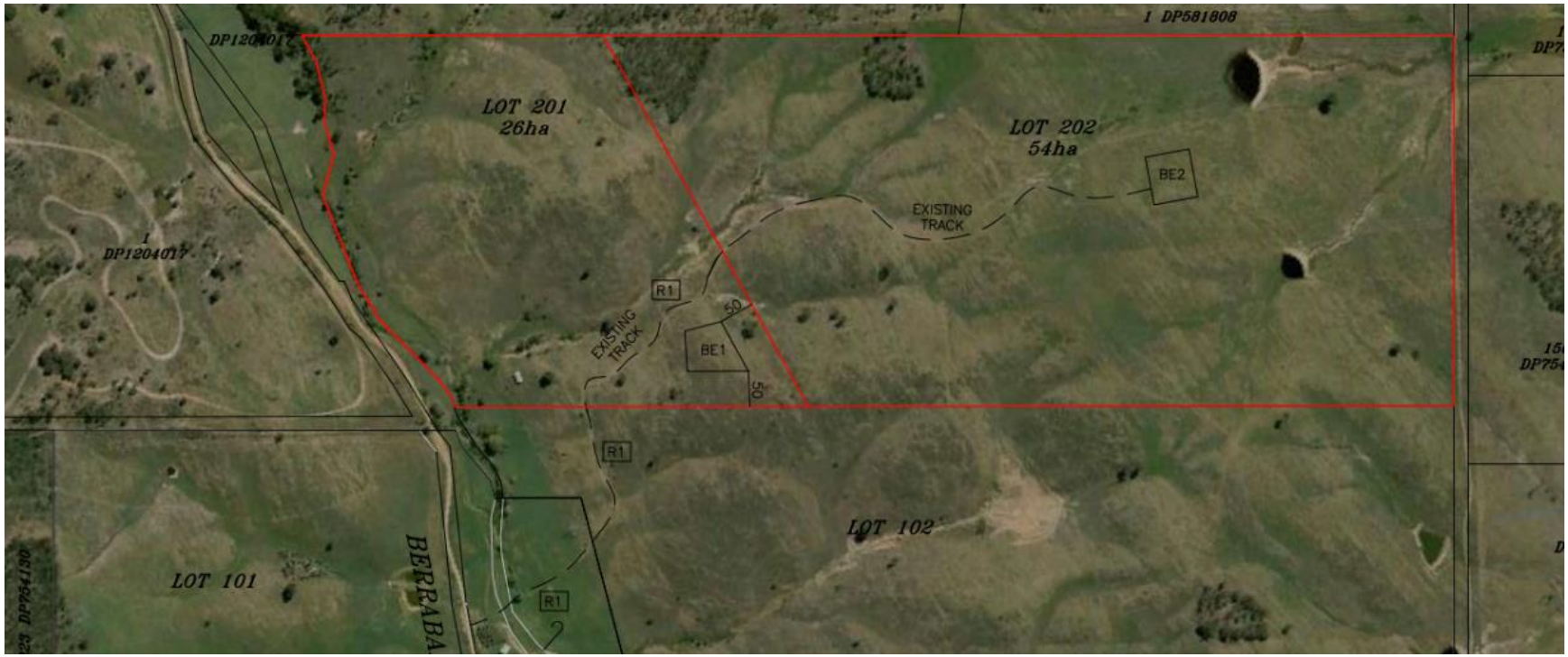

Figure 2: Sub-division layout (extract from client plans).

Intended water supply: Potable water for new lots is to be provided through roof catchment and tank storage. Non-potable water is to be provided through roof catchment and tank storage.

It is recommended that the minimum tank storage requirement for the dwelling lots be sufficient to satisfy potable, non-potable and firefighting requirements and thereby reduce the need for each lot to develop individual additional non-potable water infrastructure such as additional dams, bores or riparian water extraction.

Proposed Effluent Management: The development will rely on the onsite treatment and disposal of effluent on the dwelling lots.

Effluent disposal on each new dwelling lot will be restricted to unconstrained areas within the lot.

Effluent will be managed on-site by a combination of a NSW Health accredited secondary treatment system with effluent dispersal via surface spray.

Primary treatment and subsoil absorption systems are not considered appropriate for the development due to limited soil depth.

Local experience: Many rural developments in the area share similar site and soil constraints. The constraints identified do not present any significant problems for the establishment of new dwellings or the associated onsite disposal of effluent.

Figure 3: Looking west from proposed Lot 202.

Figure 4: Looking east from proposed Lot 202.

Figure 5: Looking north from proposed Lot 201.

Figure 6: Looking west from proposed Lot 201.

Figure 7: Looking south from proposed Lot 201.

Figure 8: Looking east from proposed Lot 201.

Figure 9: Looking across areas of erosion north of building envelope Lot 201.

Figure 10: Looking west over proposed Lot 201.

SITE AND SOIL ASSESSMENT

Climate

Cool temperate climate with mean annual rainfall of approximately 650 mm, pan evaporation 1200 mm; large moisture deficit typically occurs in summer months, small moisture surplus typically occurs in winter months.

Climate is suited to dispersal of secondary treated, disinfected effluent by surface irrigation.

Exposure

The proposed building envelopes lots have a good level of exposure being historically cleared for grazing. Groundcover is predominantly native grassland and exotic pastures with scattered remnant trees.

The level of exposure within the building envelopes is favorable for dispersal of secondary treated effluent via surface irrigation.

Slope

The site displays a range of slope gradients, from gentle to moderately steep (<5-12%). The moderately steep slopes are a moderate constraint for effluent dispersal and dwelling construction.

Areas suited to effluent disposal and dwelling construction are located on gentle to moderate slopes of <12% which are not otherwise constrained for effluent disposal or building construction.

There is an adequate area of land within each new dwelling lot which is not slope constrained for dwelling construction or effluent dispersal.

Landscape/ Landform

The majority of the area within the new dwelling lots are on upper and lower mid slopes with divergent slope form. This slope form is suited to the surface irrigation of treated effluent.

There are areas of convergent slope form on the property which generally correspond to the lower slopes and drainage depressions which are already constrained for effluent disposal practices.

There are adequate areas within the new dwelling lots with divergent slope form which is unconstrained for dwelling construction and effluent disposal. Limited areas of convergent

landscapes exist and are generally associated with drainage depressions and are therefore already constrained for dwellings and effluent dispersal.

Surface rock and outcrop

Surface rock and outcropping bedrock is common in this landscape however these features do not present a major constraint to effluent disposal within the unconstrained areas of the building envelopes.

Rock outcrop and surface stone is limited in extent in the building envelopes and not a major constraint to effluent disposal by surface spray irrigation.

Surface / shallow stone is not a constraint to dwelling construction.

Hydrology

The fine silty/sandy loam textured topsoil across the site has a moderate permeability, of 0.5 to 1.5 m/day. The clay loam to light clay subsoils have a lower permeability in the range of 0.06-0.5 m/day (from table M1 of ANZ STD 1547:2012).

Approximately 5-10% of annual rainfall forms surface runoff, although in individual high intensity storm events over 50% of rainfall may form runoff.

Rainfall that does not form surface runoff is either lost through evaporation and transpiration or infiltrates the soil. Rainfall which infiltrates soil generally drains vertically through the soil profile until it meets a less permeable subsoil layer (e.g. hard pan or clay layer), where a significant proportion drains laterally downslope as subsurface flows.

In very permeable highly fractured and vertically dipping bedrock a substantial amount of rainfall infiltrating the soil can move into the local groundwater table. Local groundwater tables can then rise to the point that discharge of groundwater occurs on the surface at points of topographical change (i.e. break of slope) or subsurface bottle necks caused by topography and / or geology. These cause local seasonal waterlogging issues which are compounded by upslope subsurface flows which generally move perpendicular to the contour of the slope and also concentrate in lower parts of the landscape. Drainage in the lower parts of the landscape is inherently slower due to lower slopes. The cumulative impact of the concentration of surface water, groundwater

discharge and subsurface flows in these parts of the landscape can be considerable seasonal waterlogging and salinity issues. There are areas of the property which are prone to seasonal waterlogging and exhibit symptoms of dryland salinity. These are mapped as constrained for effluent disposal and dwelling construction, refer **Figures 17 & 18**.

Development within catchments can change the hydrology by increasing the amount of compacted and non-permeable hard stand areas thereby reducing infiltration and subsurface flows. This is balanced by an increase in surface water runoff.

Hydrological factors are not a constraint to the construction of dwellings. The low density of new dwelling lots to be created (less than 1 dwelling per 40 hectares), results in limited potential for changes to local hydrology.

Effluent disposal will need to be appropriately designed and located to minimise hydrological impacts from surface or shallow sub-surface irrigation such as effluent run-off or rapid effluent drainage through permeable soil profiles into groundwater systems. There is an adequate area of suitable soils within the unconstrained areas of the dwelling lots.

It is recommended that areas of suitable site and soil conditions for effluent dispersal be identified on each new dwelling lots in the individual Effluent System Design Reports to be submitted as part of the Development Application to construct future dwelling(s).

Soils

A detailed soil profile description is provided in **Appendix 2** of this report.

Soils are described as the Blakney Creek Soil Landscape in the Soil Landscapes of the Goulburn 1:250,000 Sheet (Hird 1991). This landscape includes Red Chromosol on crests and side slopes with poorer drained Yellow Chromosols in drainage depressions. The soils in the steeper areas and on ridges/crests include Tenosols and Rudosols in the areas mapped as suitable for effluent dispersal are Red and Yellow Chromosols formed on Ordovician and Silurian sedimentary parent material.

They comprise a weakly structured silty or sandy loam upper layer overlying a bleached massive silty or sandy loam above a moderately structured clay loam to clay subsoil. Depth is variable from <50 – approximately 100cm.

The representative analytical data from the Soil Landscape Report shows a moderate phosphorous sorption level, non-saline subsoils and low exchangeable sodium. As such the soils are free of any significant chemical limitations to effluent dispersal.

Soil profiles from within each dwelling lots were assessed and are described in detail in **Appendix 2.**

Soil in the new dwelling lots are generally unconstrained for effluent dispersal through surface irrigation. Limited soil depth is a constraint for subsoil absorption which is not recommended for effluent disposal in either building envelope the site.

CONSTRAINTS ANALYSIS

SOIL EROSION

The soil types which dominate the site are a high erosion risk. Therefore, steeper slopes and areas where runoff is concentrated are highly susceptible to erosion.

There are no areas within proposed building envelopes mapped as high soil erodibility in the Yass LEP 2013 *(refer* ***Figure 11****).*

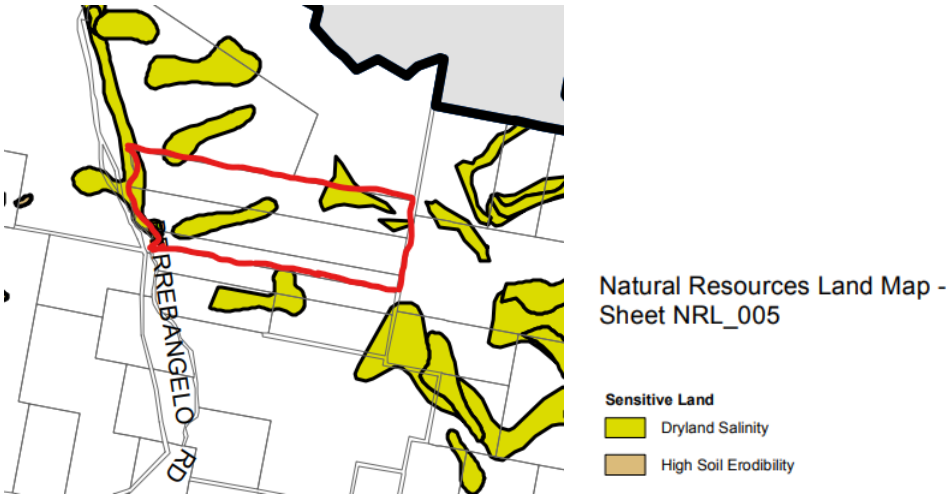

Figure 11: Yass Valley Local Environmental Plan 2013

Numerous areas of both historical and active erosion were observed during the inspection which have been mapped as constrained for both effluent disposal and dwelling construction.

Areas of erosion are constrained for the dispersal of effluent due to the potential of effluent irrigation practices to exacerbate erosion and the reduced capacity of eroded soil profiles to assimilate nutrients due to the loss of productive topsoil.

Areas of erosion also pose some risk to dwelling construction due to potential instability and the undermining of dwelling foundations and associated infrastructure by erosion.

RECOMMENDATIONS

- Effluent disposal should not be undertaken within areas of erosion.
- Dwelling construction should avoid areas of erosion.
- Greater than 70% groundcover be maintained far across the property (refer **Figure 17 & 18**).
- Groundcover by maintained at 100% in areas nominated for effluent irrigation.
- Erosion control measures should be implemented to address any areas of active erosion detected on the property.
- The construction of dwellings or other buildings or infrastructure should include appropriate soil and water management measures.

SALINITY

Dryland salinity is a significant issue across many parts of the Yass River Catchment and is related to changed landscape hydrology, climate, geology, soils and land management.

Salinity impacts grazing and crop production, water quality and contributes to increased erosion which in turn further reduces production and water quality.

It is caused by changed land use, including clearing of native perennial deep-rooted vegetation and agricultural land management activities, resulting in increased accessions (recharge) to groundwater tables from rainfall. This results in groundwater tables rising and bringing salts which are contained in geology and subsoil stores into the root zone of vegetation impacting growth and production. In certain parts of the landscape groundwater tables may discharge on the surface in what are called discharge sites. These are particularly vulnerable to reduced vegetative growth and can eventually deteriorate until they are denuded of groundcover and become saline scalds. Once bare, these sites are prone to erosion, particularly given they often coincide with drainage lines and areas of overland flow.

Salinity management often involves the reinstatement of deep-rooted perennial vegetation in recharging parts of the landscape in conjunction with reinstating or maintaining good groundcover on saline discharge areas to prevent erosion.

There are no areas of the proposed building envelopes mapped as salinity effected land mapped in the Yass Valley LEP (2013), refer **Figure 12** below**.**

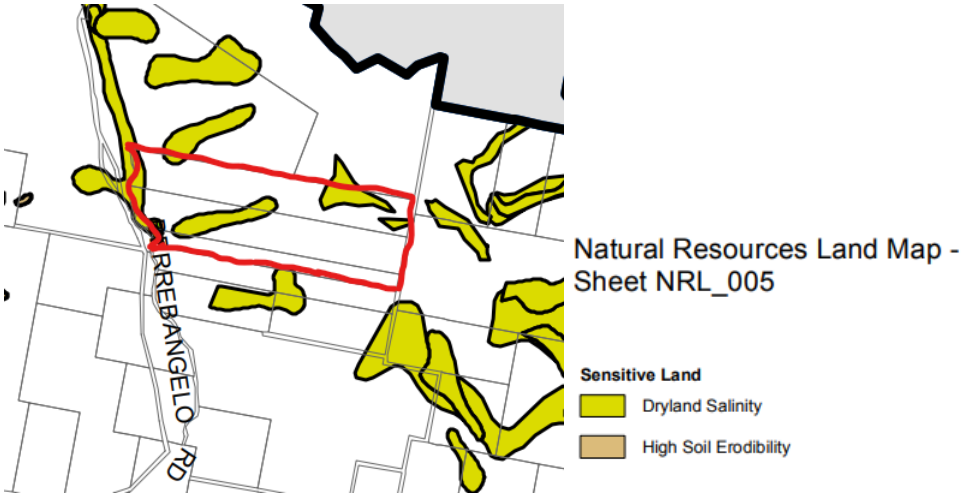

Figure 12: Yass Valley Local Environmental Plan 2013

Numerous areas of salinity related erosion were observed during the inspection which have been mapped as constrained for both effluent disposal and dwelling construction due to erosion related issues. Areas of seasonally waterlogged land related to salinity have also been mapped as constrained for effluent disposal and dwelling construction.

RECOMMENDATIONS

- Effluent disposal should not be undertaken within areas of salinity related erosion and seasonal waterlogging.
- Dwelling construction should avoid areas of salinity related erosion and seasonal waterlogging.
- The area of deep-rooted perennial species should be maintained across the property including retaining existing trees and shrubs.

GROUNDWATER The site is mapped as moderate to moderately high groundwater vulnerability on the Department of Land and Water Conservation (2001) Groundwater Vulnerability Map of the Murrumbidgee Catchment.

No areas of the property are mapped on the Yass Valley LEP 2013 Groundwater Vulnerability Map, see **Figure 13** below.

Figure 13: Yass Valley Environmental Plan 2013 - Groundwater

Figure 14: Bores https://realtimedata.waternsw.com.au/water.stm

There are no bores within 500m of either Building Envelope. The closest bore is GW401638 with a depth of 45m and water bearing zones at 27-32m. It is approximately 1,500m southwest of the BE on Lot 201.

The risk of contamination or any other adverse impacts to quantity and quality of groundwater available for other users resulting from the on-site effluent dispersal practices related to the development, are considered minor due to:

- horizontal separation of >1,000m between bore and effluent disposal areas on Lots 201 & 202,

- vertical separation of greater than 27 metres to standing water level in the nearest bore,
- relatively low application rate of secondary treated disinfected effluent,
- application of high-quality secondary effluent to the surface through irrigation maximizing evapotranspiration and minimising opportunity for deep drainage
- recommended measures available to mitigate impacts (detailed below).

RECOMMENDATIONS

- Maintain a minimum 250m buffer between existing and any future bores and effluent dispersal areas within Lots 201 & 202.
- Require a water supply work approval to be sought prior to constructing a bore or well.

RIPARIAN LANDS

Figure 15: Yass Valley Environmental Plan 2013 – Riparian Lands

The proposed new dwelling Lot 201 includes areas of mapped watercourse on its western boundary associated with Hickey's Creek shown on the Riparian Lands and Watercourses Map-Sheet CL2_005 (refer above).

NSW DPI Office of Water (Guidelines for riparian corridors on waterfront land) defines the riparian corridors required for different stream orders, to maintain the integrity of these sensitive riparian areas, refer **Figures 16 & 18.**

Figure 2. The Strahler System

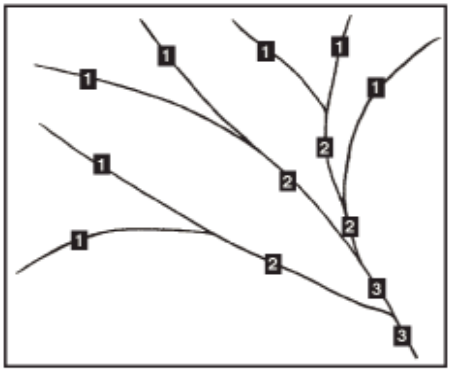

Table 1. Recommended riparian corridor (RC) widths

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

Figure 16: Stream ordering and riparian corridor widths (NSW DPI Water Guidelines)

The property borders Hickeys Creek which is a 4th of Higher Order Stream and includes section of 1st Order Streams on both Lots 201 & 202. These drainage features will require a 40 metre and 10 metre buffer respectively, within which construction of buildings or associated infrastructure is inconsistent with Water NSW Guidelines for riparian management. These riparian areas are mapped as constrained for building construction, refer **Figure 18.**

RECOMMENDATIONS

- No dwelling or related infrastructure construction is to occur within the 40m buffer from the 4th or Higher Order Hickeys Creek or the 10-metre buffer from the 1st Order Stream on Lot 201 (mapped as constrained in **Figure 18**).
- No dwelling or related infrastructure construction is to occur within the 10-metre buffer from the 1st Order Stream on Lot 202 (mapped as constrained in **Figure 18**).
- Any watercourse crossings should be designed in accordance with NRAR guidelines and any necessary approvals.

DRAINAGE BUFFERS – EFFLUENT DISPERSAL

The *ANZ Standard 1547:2012 On-site Domestic Wastewater Management and On-site* and *Sewage Management for Single Households* (The Silver Book) NSW Govt, 1998, require appropriate buffers between drainage depressions, creeks and rivers and effluent dispersal areas. These include a 100 metre buffer from permanent surface waters including Hickeys Creek, streams and major creeks, and a 40m buffer from any other water including intermittent waterways, dams and drainage channels.

The property borders Hickeys Creek along the eastern boundary and 1st Order Streams on Lots 201 & 202 and numerous drainage depressions and farm dams. All of these drainage features require buffers from effluent disposal practices.

Approximate locations for drainage buffers are shown in **Figure 17**. There are adequate areas within each proposed building envelope outside these buffers which is considered suitable for effluent disposal.

Recommendations

- All land designated for effluent dispersal will be located outside 100m watercourse buffer from Hickeys Creek as mapped in **Figure 17**.
- All land designated for effluent dispersal will be located outside the 40m drainage depression buffers as mapped in **Figure 17**.
- All land designated for effluent dispersal will be located outside the 40m buffer from farm dams a mapped in **Figure 17**.
- The buffers required between effluent dispersal practices and drainage depressions and dams do not apply to dwellings or other built infrastructure.

MANAGEMENT OF EFFLUENT

Summary This report assesses the general availability of an adequately sized area of land within the proposed dwelling lots.

A minimum area of 1,200 m^2 has been used as the benchmark for the area required for the effluent dispersal. This is a conservative approach, given that an irrigation area for a six-bedroom dwelling will be around 520 m^2 and guidelines require that an equal size reserve effluent disposal area is also available. The location of future buildings, paths, tanks, pools and other infrastructure will also need to allow for the required buffers within the unconstrained areas of the dwelling lots.

Key constraints to effluent dispersal on the lot are the Yass River watercourse buffer of 100m and dam and drainage buffers of 40m.

The proposed new dwelling lots have an adequate area of land that is no constrained and is therefore suited to effluent dispersal. There is also an adequate remaining area that is available for the construction of dwellings and associated infrastructure, including an allowance for the necessary buffers between these features, refer **Figure 17**.

The most widely used form of effluent treatment on relatively unconstrained rural residential developments in the region is a NSW Health accredited aerated wastewater system, with the secondary treated, disinfected effluent irrigated onto the surface. Reliability and maintenance issues with such systems are well known and the risk of failure is relatively low.

There are a number of more innovative options for effluent treatment and disposal. The most promising of these is the Wisconsin sand mound, of which there are a small number in the region. These systems have a small footprint, (less than 150m^2), have a high degree of reliability and have a low energy requirement. There is however a lack of experienced installers for such systems in the region and the climate presents some issues in terms of maintaining grass cover through hot dry summers if effluent is not being regularly loaded into the mound. This is generally only an issue if the attached dwelling is not permanently or fully occupied.

In general, the area is not recommended for subsoil absorption of primary treated effluent due to limited soil depth. As a result, both subsoil absorption and evapotranspiration/absorption beds for primary treated effluent are not recommended for the site.

The use of subsoil irrigation beds for dispersal of wet composting closet treatment systems (eg worm farms) are also considered unsuited to the site.

The following section addresses the specific requirements for a number of suitable effluent management options in order to show that on-site effluent can be achieved sustainably on the subdivision.

This report assumes that a detailed planning for effluent management will occur at the time of submitting building plans to council. At this stage the exact location, footprint, occupancy and usage patterns of the proposed dwelling will be known. These are all critical elements of the final design process which cannot be addressed by this report.

Secondary treatment system and surface irrigation

NSW Health accredited systems treat effluent to a minimum secondary standard, suitable for disposal by surface or subsurface irrigation (see list at http://www.health.nsw.gov.au/PublicHealth/environment/water/wastewater.asp). This includes aerated wastewater treatment systems (AWTS), sand and textile filters and biological filters.

The sizing of the effluent irrigation area is based on nutrient balance which gives a general guide to a sustainable area required for irrigation.

It is preferable that effluent irrigation systems on lots be semi fixed installations which limit the potential for effluent irrigation within constrained areas. Surface spray irrigation systems can be significantly improved by having at least two or three lines of sprinklers on risers attached to rigid supports, 30-50cm above ground level, with each riser tied into the delivery line. A manual valve on each line allows all or some of the lines to be used. The buried distribution lines with risers minimises the risk of damage by mowing and encourages the irrigation area to be better managed than current practice.

The size of the area required for effluent irrigation will vary according to the number of bedrooms in the dwelling, which determines the design

effluent loading. Based on the hydraulic and nutrient balance shown in **Appendix 3**, the sizing of the irrigation area is shown below:

Three bedrooms	300m2
Four bedrooms	370m2
Five bedrooms	450m2
Six bedrooms	520m2

Council also requires adequate suitable land for a reserve effluent dispersal area. Additionally, buffers of 15m are required from dwellings (for surface spray), 6m from downslope buildings, property boundaries and driveways and 3m if these features are located upslope and 6m from swimming pools.

Primary treatment and subsoil absorption

Generally, not suitable due to shallow, low permeability soils, proximity to Yass River and location within area of groundwater vulnerability.

Innovative effluent management systems

A Wisconsin mound pump dosed from a septic tank may be suited to the site and soil conditions. Mound design would need to be developed on a site by site basis, including a soil profile at the mound site. Indicatively, based on the soil profiles for this assessment, the Basal Loading Rate would be 16mm/day and Linear Loading rate 47mm/day. The footprint would be slightly less than 150m2 on a flat or gently sloping site.

Effluent management

Recommendations

- A lot specific *site and soil assessment for on-site effluent management* will be required at the time of submitting building plans to Council for the new dwelling entitlements and the prescriptions of this report should be applied to the design process of the lot.
- Management prescriptions for on-site effluent management should be detailed in specific On-Site Sewage Management report(s) to be provided with Development Application(s) for the construction of dwelling(s).
- Any effluent disposal practices should be confined to within building envelopes which are not mapped as constrained for this purpose on new dwelling lots, refer **Figure 17**.
- Buffers to be applied to effluent dispersal areas will include:
  - 40 m from all dams and drainage depressions
  - 100 m from any existing or future upslope bores
  - 250 m from bores
  - 15 m from dwellings (for surface spray irrigation)
  - 6 m from property/lot boundaries (3 m if these are upslope)
  - 6 m from buildings and driveways (3 m if these are upslope)
- The effluent management system suitable for the lot include an aerated wastewater treatment system (including disinfection) with NSW Health accreditation, dispersing effluent to a designated effluent surface irrigation area. The irrigation area size should be based on occupancy derived from bedroom number.
- As a guide, the following areas would be appropriate for the soil and site conditions of the site:
  - Three bedrooms……...300m^2
  - Four bedrooms……370m^2
  - Five bedrooms…….450m^2
  - Six bedrooms……520m^2
- To ensure effective distribution of treated effluent, and provide protection of irrigation lines, the minimum requirement for irrigation dispersal should be buried distribution lines attached to a moveable surface sprinkler line. Alternatively, a fully fixed system comprising decoupling sprinkler heads and a minimum of two runs of distribution lines connected by a manual valve to allow for alternating dispersal areas.
- More innovative systems such as a Wisconsin sand mound treating primary effluent from a septic tank, or a recirculating sand filter with a subsurface irrigation field, are also suitable.

- A subsoil absorption bed receiving primary treated effluent is generally not considered suitable for the site.

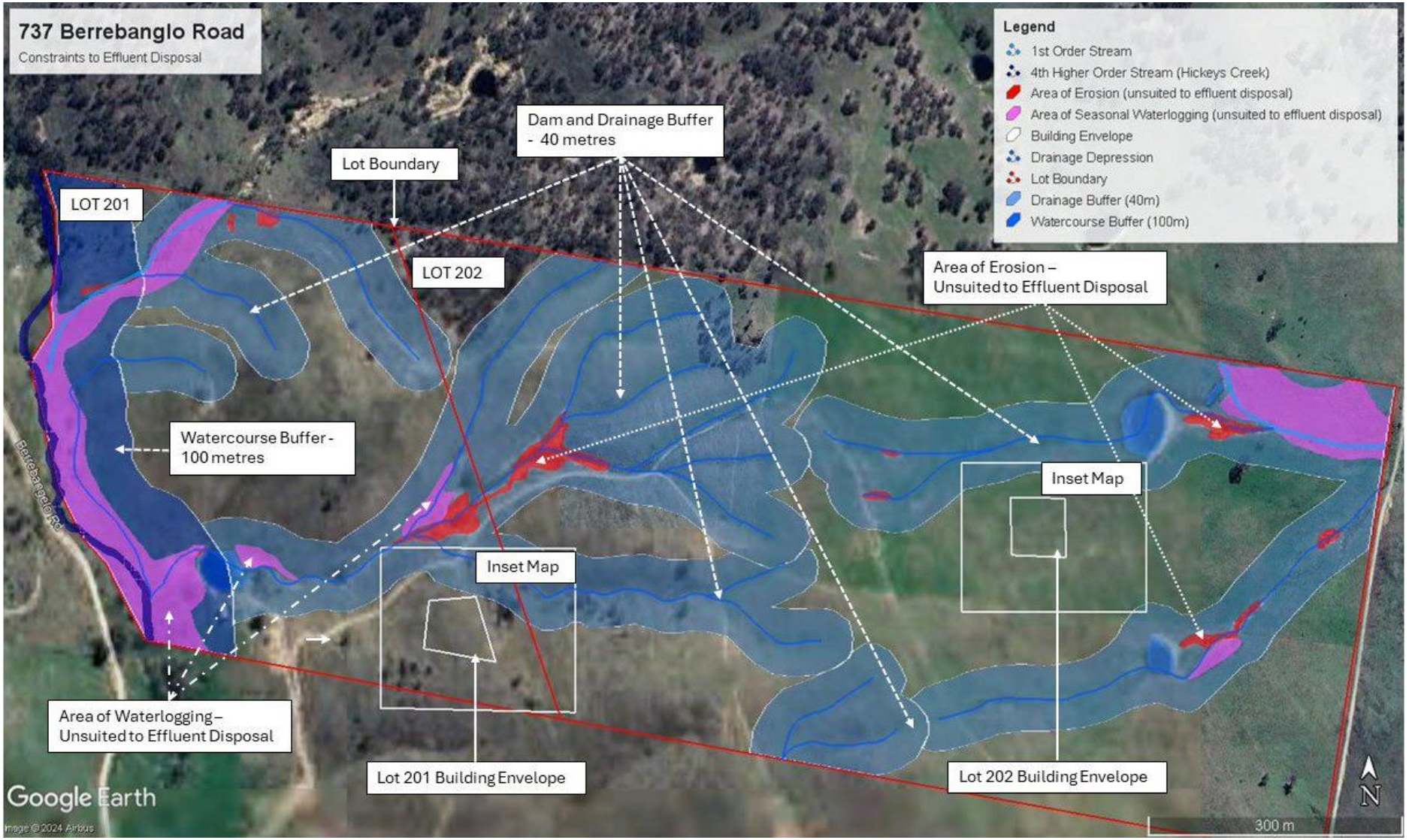

Figure 17a: Constraints to effluent dispersal.

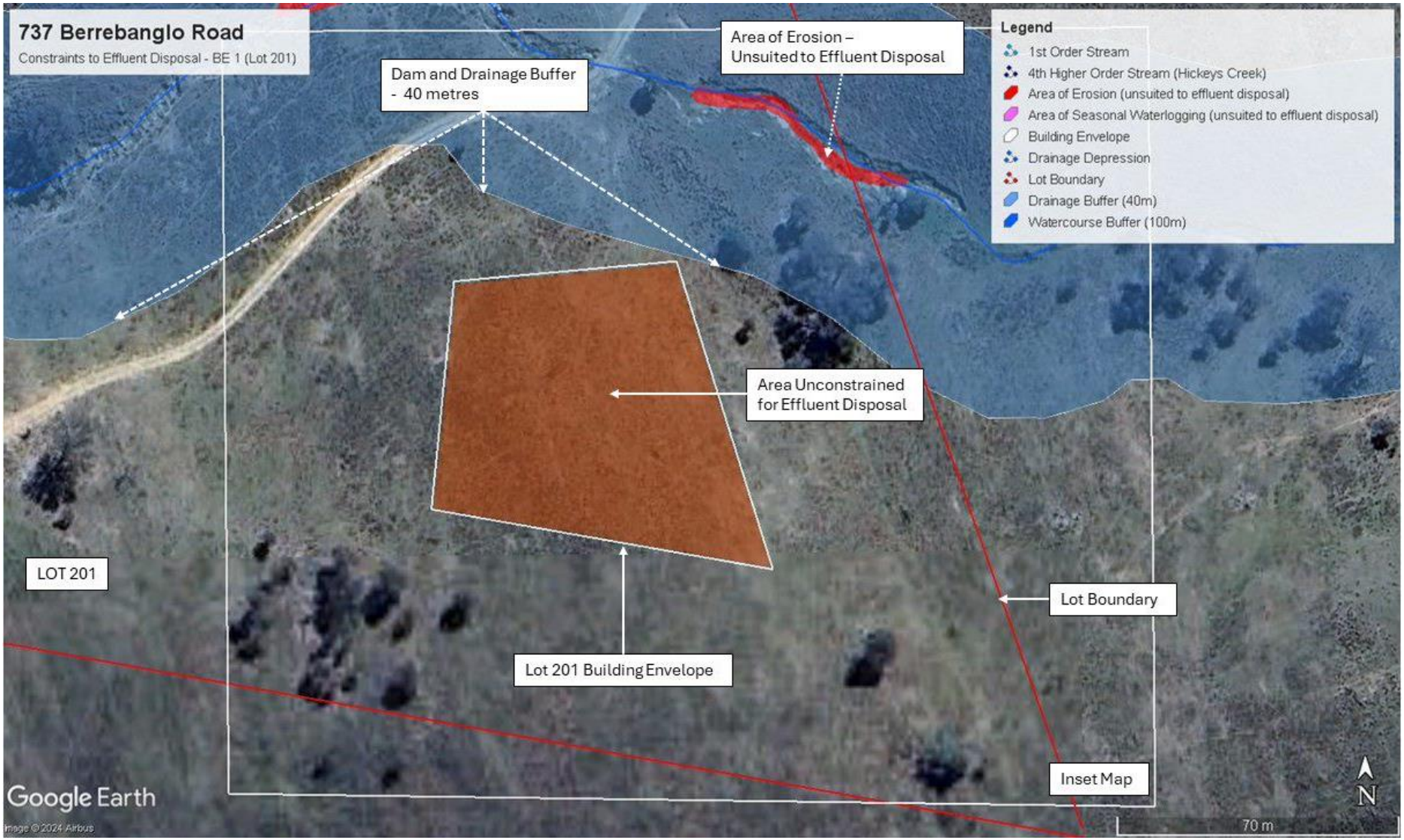

Figure 17b: Constraints to effluent disposal - Lot 201

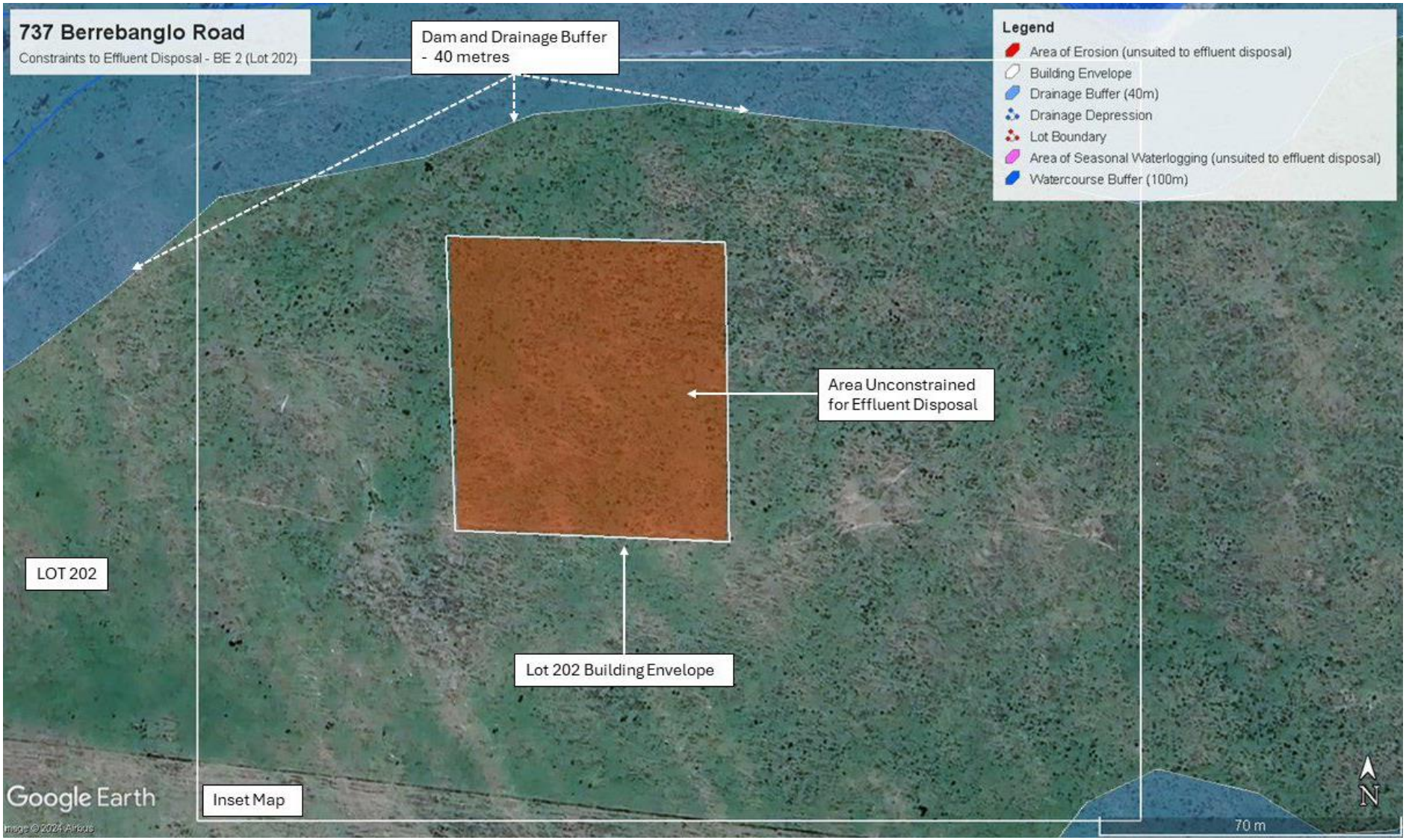

Figure 17c: Constraints to effluent disposal - Lot 202

CAPABILITY FOR DWELLING CONSTRUCTION

Summary

Land considered unsuitable or constrained for the construction of dwellings generally consists of areas with the following attributes:

- a slope grade of 15% - the threshold is consistent with many building codes and Council requirements and also corresponds to the slope above which erosion hazard significantly increases (Landcom, 2004)
- areas of active erosion, refer **Figure 18**
- seasonally waterlogged or flood prone land - including the minor flow lines which drain the site and dams
- unsuitable soils – including highly erodible dispersive soils, low wet bearing strength soils and unstable soils prone to movement.
- areas within NSW DPI Office of Water Guidelines for riparian zone management, refer **Figure 18**.

The 100m buffer from Hickeys Creek River and the 40m buffer on minor drainage lines and dams required for effluent disposal areas, do not apply to dwelling construction.

The proposed building envelopes have adequate areas of generally unconstrained land suitable for dwelling construction.

Dwelling construction

Recommendations

- Building construction will be restricted to land within new dwelling lots which are shown in this report as unconstrained, refer **Figure 18**.
- A Site Classification shall be conducted prior to the construction of any additional buildings within the dwelling lots to confirm the suitability of soil for construction.

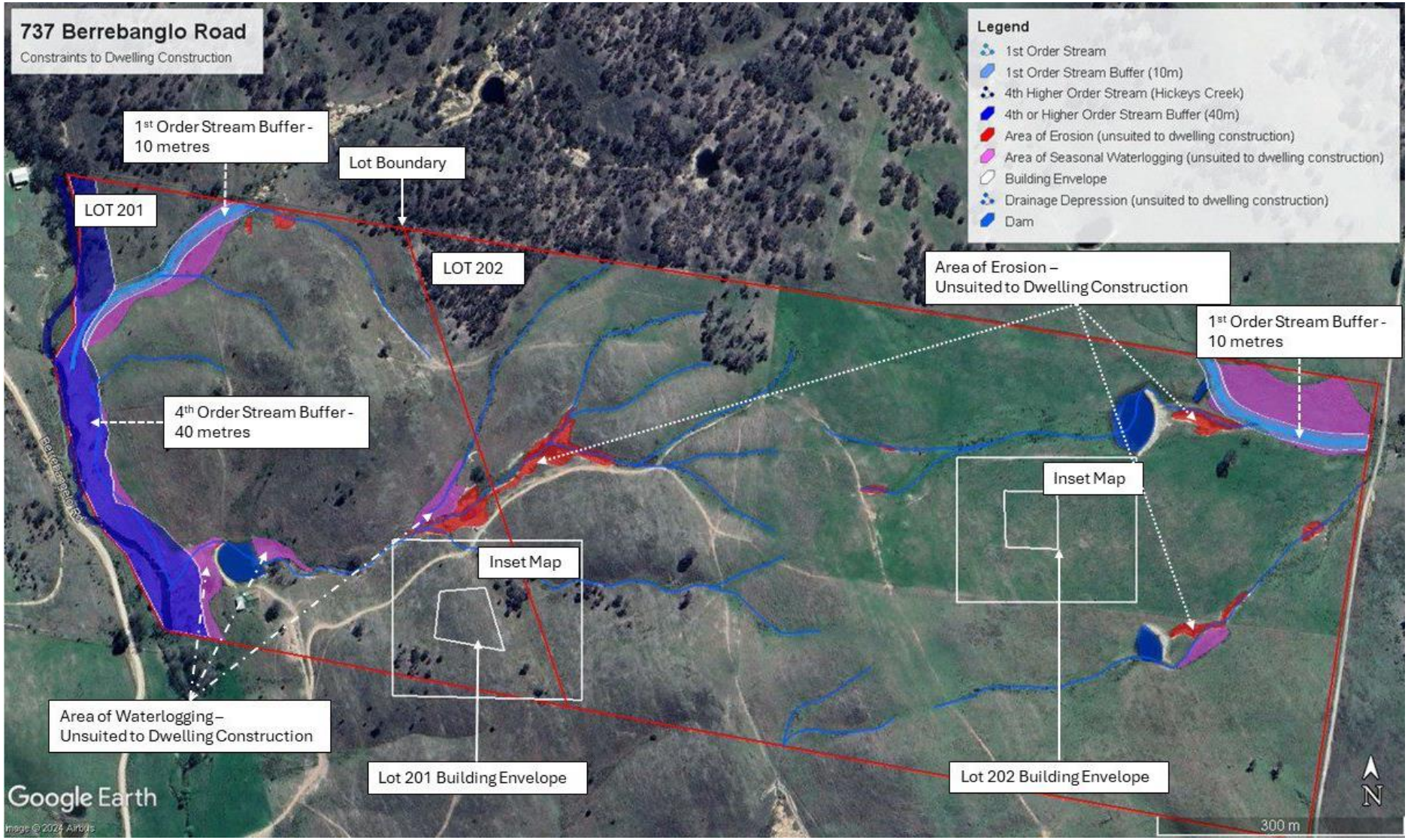

Figure 18a: Constraints to dwelling construction.

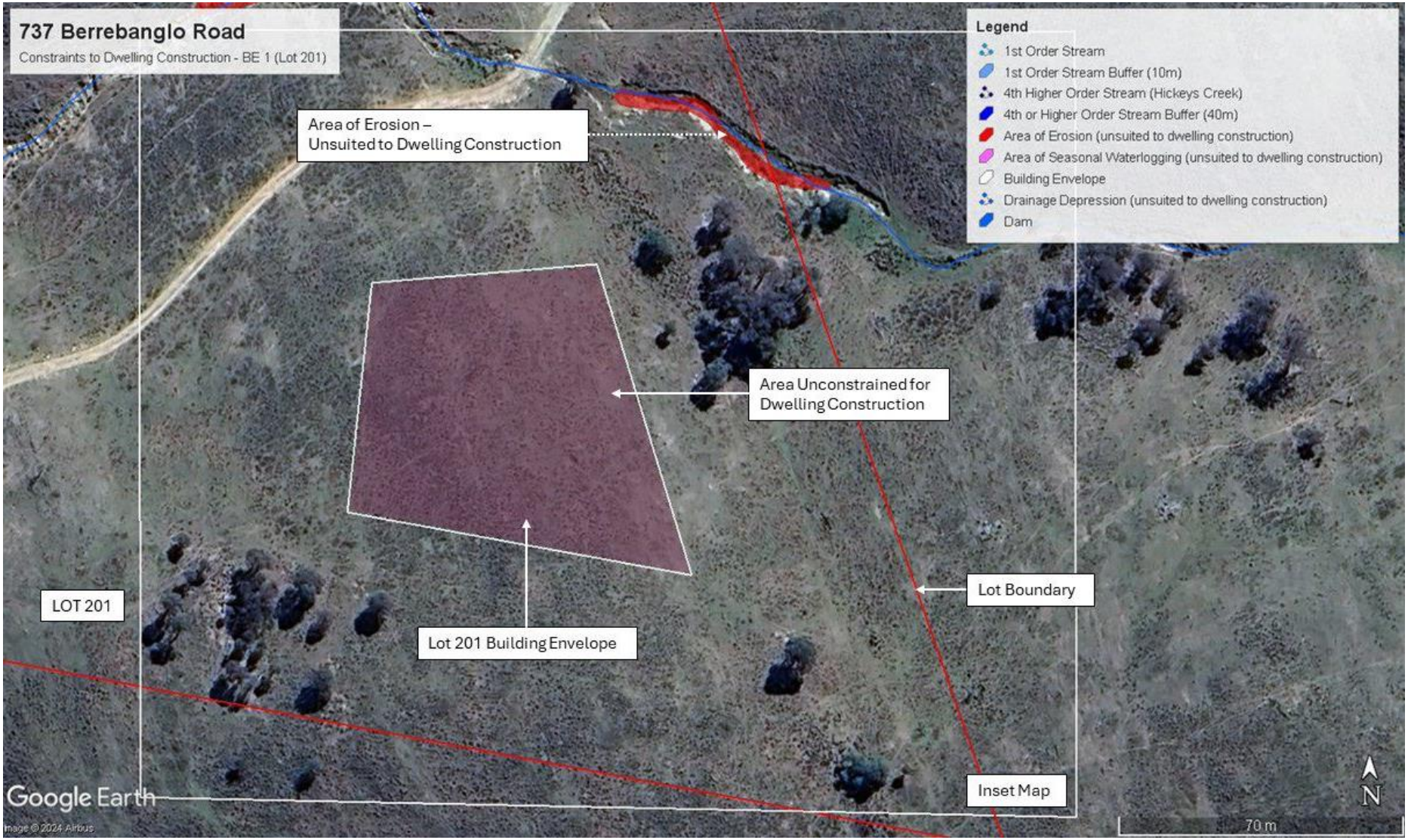

Figure 18b: Constraints to dwelling construction – Lot 201.

Figure 18c: Constraints to dwelling construction – Lot 202.

APPENDIX 1: SITE AND SOIL LIMITATION ASSESSMENT

The following two limitation tables are a standardised guide to the site and soil characteristics which may limit the suitability of the site for effluent disposal and which would require attention through specific management practices. The tables have been reproduced from *On-site Sewage Management for Single Households* (tables 4 and 6, Anon, 1998). The highlighted categories represent site and soil conditions of the land covered in this report. The tables show that the land designated for effluent application has slight to moderate limitations, but no severe limitations.

Site limitation assessment

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Flood potential	All land application systems	> 1 in 20 yrs.		Frequent, below 1 in 20 yrs	Transport in wastewater off site
	All treatment systems	components above 1 in 100 yrs.		Components below 1 in 100 yrs.	Transport in wastewater off site, system failure
Exposure	All land application systems	High sun and wind exposure		Low sun and wind exposure	Poor evapo-transpiration
Slope %	Surface irrigation	0-6	6-12	>12	Runoff, erosion potential
	Sub-surface irrigation	0-10	10-20	>20	Runoff, erosion potential
	Absorption	0-10	10-20	>20	Runoff, erosion potential
Landform	All systems	Hillcrests, convex side slopes and plains	Concave side slopes and foot slopes	Drainage plains and incised channels	Groundwater pollution hazard, resurfacing hazard

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Run-on and seepage	All land application systems	None-low	Moderate	High, diversion not practical	Transport of wastewater off site
Erosion potential	All land application systems	No sign of erosion potential	Minor stabilized sheet and gully erosion	Indications of erosion e.g. rills, mass failure	Soil degradation and off-site impact
Site drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness	Groundwater pollution hazard, resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence
Land area	All systems	Area available		Area not available	Health and pollution risk
Rock and rock outcrop	All land application systems	<10%	10-20%	>20%	Limits system performance
Geology	All land application systems	None	Small areas of isoclinal fractured regolith outcrop	Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard

Soil limitation assessment

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Depth to bedrock	Surface and sub surface irrigation	> 1.0	.5-1.0	< 0.5	Restricts plant growth
or hardpan (m)	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Depth to seasonal water table (m)	Surface and sub surface irrigation	> 1.0	0.5-1.0	< 0.5	Groundwater pollution hazard
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Permeability	Surface and sub surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive runoff and waterlogging
Class	Absorption	3, 4		1, 2, 5, 6	Percolation
Coarse fragments %	All systems	0-20	20-45	>40	Restricts plant growth, affects trench installation
Bulk density (g/cc) **SL** **L, CL** **C**	All land application systems	 < 1.8 < 1.6 < 1.4		 > 1.8 > 1.6 >1.4	restricts plant growth, indicator of permeability
pH	All land application systems	> 6.0	4.5-6.0	-	Reduces plant growth

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Restricts plant growth
Sodicity (ESP)	Irrigation 0-40cm; absorption 0-1.2mtr	0-5	5-10	> 10	Potential for structural degradation
CEC mequiv/100g	Irrigation systems	> 15	5-15	< 5	Nutrient leaching
P sorption kg/ha	All land application systems	> 6000	2000-6000	< 2000	Capacity to immobilise P
Aggregate stability	All land application systems	Classes 3-8	class 2	class1	Erosion hazard

APPENDIX 2: SOIL PROFILE DESCRIPTIONS

Soil Profile 1: Building Envelope Lot 201

Soil classification	Depth (cm)	Properties
TENOSOL	0-40	A Brown silty loam, dry and friable, massive to weak structure, 5-10% coarse fragments as small stones up to 35mm.

Figure 18: Soil profile 1 Building Envelope Lot 201

Soil Profile 2: Building Envelope Lot 202

Soil classification	Depth (cm)	Properties
RED CHROMOSOL	0-30	A Brown silty loam, dry and friable, massive to weakly structured, 5-10% coarse fragments, as small stones up to 35mm
	30 - 90	B Red/orange silty clay loam, moist and friable, weak structured, 5-10% coarse fragments as small stones, <40mm Terminates in rock

Figure 19: Soil profile 2 - Building Envelope Lot 202

APPENDIX 3: EFFLUENT AREA DESIGN

Using the DIR for irrigation on clay loam soils of 3.5 mm/day and adopting the design loading of 480 L/day, the following land application areas are required to manage additional hydraulic loading, nitrogen and phosphorous generated:

Water balance

- **Sizing based on hydraulic loading:**

A = Q (l/day)/DIR (mm/day)
where A = area; Q = 480 l/day; DIR = 3.5 mm/day
A = 480/3.5 = 137 m^2
Area required = 150 m^2

Nitrogen balance

- **Sizing based on nitrogen balance:**

A = Q(l/day) X TN (mg/l)/L_n (critical loading of TN, mg/m^2/day)
where A = area; Q = 480 l/day; TN = 25mg/l (from Silver Book)
Assume 20% loss by denitrification; 25mg/l – (25 X .2) = 20mg/l
L_n = 15,000mg/m^2/yr (ie 150kg/ha/yr, for introduced species)
A = 480 X 20 X 365/15,000 = 234m^2
Area required = 250 m^2

Phosphorous balance

- **Sizing based on phosphorous balance**

A = P_{gen}/(P_{uptake} + P_{sorb}) [P sorption capacity in upper 50cm & 50 year design period]
P_{gen} = 10mg/l X 480 X 365 X 50 = 87.6kg
P_{uptake} = 4.4mg/m^2/day X 365 X 50 = .080kg/m^2
P_{sorb} = 2,164kg/ha = .216kg/m^2
A = 87.6/(.08+ .216) = 296 m^2
Area required = 300 m^2

Design effluent disposal area

Therefore, a land application area of **300 m^2** will account for phosphorous, nitrogen and water applied based on estimated connections and usage patterns associated with the construction of a 3-bedroom house.
An allowance of a reserve land application area will double this area to **600m^2**.

Alternative Dwellings

The size of the effluent irrigation area required to service dwellings with 4, 5 & 6 bedrooms are provided below:

- 4 bedrooms – 370 m^2
- 5 bedrooms – 450 m^2
- 6 bedrooms – 520 m^2

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