SOILANDWATER

LAND CAPABILITY ASSESSMENT

Lot 1 DP32236
2155 Sutton Road
SUTTON NSW 2620

4 June 2025 (V04)

FRANKLIN CONSULTING AUSTRALIA PTY LIMITED
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SOILANDWATER

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SUMMARY

Soil and Water was engaged by Chase DM to support the proposed 21 lot subdivision of 2155 Sutton Road, Sutton (Lot 1 DP32236).

The subdivision of the existing 73-hectare parcel will create the following lots:

Lots 1-19 19 large residential lots with average size of 5,000m^2 each containing a building entitlement. These lots will be accessed from Majura Lane (Guise Street) and via an internal road.

Lot 20 12.99 hectares located between the central drainage depression and Sutton Road. This lot will include a new dwelling entitlement.

Lot 21 48.75 hectares located in the southwest corner of the block containing the existing horse yards and shelters. This lot includes an existing house, shed and infrastructure.

Adequate areas of unconstrained land for effluent dispersal and dwelling construction

All lots will dispose of domestic effluent on-site via independent effluent treatment and disposal systems. High quality treated and disinfected effluent generated by these systems will help offset the potable water requirements for each lot and make these independent water supplies more viable.

It is proposed that potable water supply for the existing and proposed dwellings will be through the independent capture and storage of roof water in potable water tanks.

Recommended effluent management measures and constraints

It is considered that there are adequate areas of suitable site and soil conditions located on the proposed residential Lots 1 – 19, to enable the on-site dispersal of effluent in association with the proposed dwelling sites.

All lots will have an Aerated Wastewater Treatment System which will provide high quality treated effluent for beneficial reuse, thereby reducing the amount of non-potable water required from other sources, to sustain areas of lawn/garden. For lots 1-19 this should be combined with the lower risk subsurface drip irrigation dispersal system.

Some of the lots adjacent to the adjacent drainage depressions will be partially constrained by drainage buffers. The location of dwelling and effluent system layout and design will need to accommodate these constraints.

Proposed Lot 20 is moderately constrained by the dam and drainage buffers associated with the drainage depressions flowing west from culverts beneath Sutton Road. Lot 20 also includes an area constrained by the drainage buffer along the main central watercourse. There are also small areas of dryland salinity and seasonal waterlogging which are constrained for onsite effluent disposal. There is however, a large area of unconstrained land which is suitable for onsite effluent disposal and dwelling construction outside the constraints identified on the lot.

The existing effluent management system on proposed Lot 21 will not be impacted by the proposed subdivision and is therefore considered adequate to continue to manage effluent generated from the existing dwelling.

The development will not adversely impact groundwater or surface water resources providing it is implemented in accordance with the recommendations of this report and relevant Council conditions.

The development will not adversely impact dryland salinity, nor will it be adversely impacted by this issue.

Planning requirements

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 the NSW guideline*, The Silver Book*;
- assessment of land capability for dwellings is based on excluding land which has a slope grade in excess of 15 %, saline, waterlogged or eroding and is as a result constrained for the construction of dwellings.

In addition to assessing the suitability of the proposed development based on capacity for onsite effluent disposal and dwelling construction, the report also assesses:

- Degree of impact on watercourses and groundwater aquifers, including the availability of mitigation options and water licensing and/or approvals,
- Degree of impact on, or from, dryland salinity, and
- Degree of impact on riparian zones.

A separate assessment has been conducted to determine the suitability of the planned rural residential dwelling lots based on the degree of impact on flora, fauna and biodiversity values attributable to each lot and the availability of mitigation options.

REPORT SCOPE AND TECHNICAL REFERENCES

The report incorporates the results of an assessment of land capability for the proposed development.

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.
- *Soils and Construction: Managing Urban Stormwater - 4th Ed. Landcom NSW Government, 2004.*
- *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 Environmental Plan (2013)*

SITE & DEVELOPMENT INFORMATION

Local Government Area	Yass Valley Council.
Developer	John Sutcliffe, Chase DM
Address	Lot 1 - DP 32236, 2155 Sutton Road, Sutton, NSW

Figure 1: Regional location

Proposed subdivision layout:

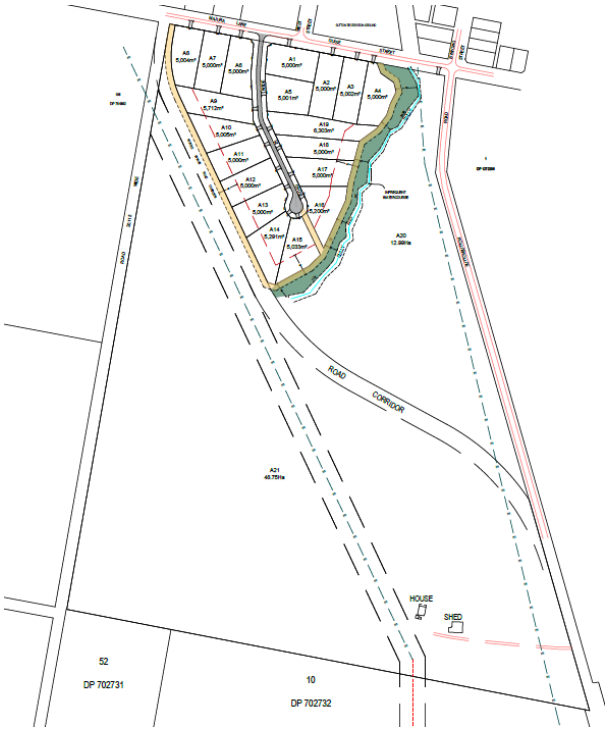

Figure 2: Subdivision layout – extract (refer to surveyed plans)

Intended water supply

Potable water will be provided through roof catchment and tank storage. Potable water supplies will be independent for each new dwelling lot and will be managed by the landholder.

The amount of potable and non-potable water required to support a household varies depending on the type and size of garden, number of occupants and occupancy patterns, and water usage patterns. Many households in rural areas provide all potable and non-potable water requirements through roof catchment and tank storage. Therefore, it is considered a viable water supply for these purposes.

Independent non-potable water supply systems generally lead to more conservative household water use as people actively monitor and manage water use commensurate with the amount of stored water available, thereby reducing the amount of non-potable water required and the impact on the broader environment.

Using an independent water supply (as opposed to a reticulated non-potable supply), reduces the estimated daily effluent load generated by an average house. For example, a 4-bedroom household with an independent water supply will generate 600 litres of wastewater per day whereas the same household with reticulated supply will generate 750 litres per day, an increase of 25%. The reduced wastewater load is beneficial to the environment and more cost efficient for the household, which can be managed with a smaller less expensive wastewater treatment system.

Independent water supplies for each dwelling lot can also be more resilient during periods of drought as minimum roof area and large tank storage capacity, combined with more conservative household water use and active monitoring and management of water use, results in households managing consumption commensurate with diminishing water availability through the course of the drought. Reliance on a reticulated water supply can create a complacency around water use which encourages landowners to establish higher water use gardens, landscape plantings and habits which then require an unsustainable level of water use during dry periods. This accelerates the decline in the availability of the reticulated water supply and can lead to the

complete failure of the reticulated water supply severely impacting all users. Water users in these scenarios tend to blame the adequacy of the water supply rather than reflect on their water use habits.

Failures of a limited number of independent water supplies during drought are easier to manage and tend to lead to a change in practice amongst the effected landholders, who observe other households (with different practices) being able to manage through drought.

There are also several measures which can be employed to increase the viability of roof catchment and tank storage as the primary water supply. These include mandating minimum roof catchment areas (dwelling and sheds); mandating minimum tank storage requirements; and mandating water saving water fixtures throughout all dwellings. Another key water efficiency measure is requiring each new dwelling to install Aerated Wastewater Treatment Systems which enables the beneficial re-use of treated effluent for garden irrigation. For a 4-bedroom household this can deliver an estimated 219,000 litres of treated effluent for garden.

The development will require each new dwelling lot to have a minimum roof catchment area and tank storage capacity. In addition, all lots will have an Aerated Wastewater Treatment System which will provide high quality treated effluent for beneficial reuse, thereby reducing the amount of non-potable water required from other sources, to sustain areas of lawn/garden.

Effluent Management

Effluent for the new building envelopes created by subdivision will be managed on-site via Aerated Wastewater Treatment Systems (AWTS), combined with effluent dispersal of surface spray or drip, or subsurface irrigation.

The higher quality effluent generated by AWTS, combined with the lower risk subsurface drip irrigation dispersal system, may be mandated in more constrained areas associated with the residential Lots 1-19, which corresponds to the area of groundwater vulnerability and are within the buffer distance required from existing groundwater bores.

The lower density rural Lot 20, will use Aerated Wastewater Treatment Systems (AWTS), combined with effluent dispersal of surface spray or drip, or subsurface irrigation.

The dwelling constructed on proposed Lot 21 will continue to use the existing treatment system in accordance with Council requirements.

Lots 1-19 will use Secondary Effluent Treatment Systems, including disinfection, combined with sub-surface drip irrigation, to minimise potential impacts to the vulnerable groundwater systems and surrounding bores.

Local experience

The major constraints related to on-site effluent dispersal are the buffer distances required from drainage depressions and dams. Many similar rural residential developments have been established in the region which share a similar range of constraints. Generally, these have not posed significant problems to the successful establishment and operation of rural residential land use and related infrastructure.

Figure 3: Gently undulating improved pasture grazing country including some farm dams (2025).

Figure 4: 2nd order stream intersecting the property flowing south to north to McLaughlins Creek (2025).

Figure 5: Looking from main watercourse towards culverts under Sutton Road (2025).

Figure 6: Dam overflow outlet on dam wall of Dam 3 (2025).

Figure 7: Looking east across areas suited to onsite effluent disposal (2025).

Figure 8: Looking north west over area of seasonal waterlogging near Guise Street (2025).

Figure 9: Looking north at culvert under Guise Street (2025).

Figure 10: Looking north at small culvert under Guise Street (2025).

SITE & SOIL ASSESSMENT

Climate

Cool temperate climate with mean annual rainfall of approximately 650 mm, pan evaporation 1,200 mm; large moisture deficit typically occurs in summer months, small moisture surplus typically occurs in winter months.

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

Exposure

The majority of the site is exposed with only small areas on Lot 21 (northwestern boundary) with some protection from shelter belt plantings of exotic pine trees. The remainder of the property has very limited scattered paddock trees and some roadside vegetation along Sutton Road and Guise Street.

The level of exposure is highly favorable for dispersal of secondary treated effluent via surface or subsurface irrigation.

Slope

The site displays a range of slope gradients, from flat to small areas of low to moderate slopes up to 10%. Elevations generally range between 650-670 metres.

The low to moderately sloping land (6-10% gradient) presents a low to moderate constraint to surface irrigation development but is generally a low constraint to other forms of effluent dispersal and are generally not a constraint to dwelling construction - therefore no slope areas have been mapped as constrained.

Landscape

The landscape is dominated by the central 2nd order stream which flows south to north to join McLaughlins Creek and eventually flows to the Yass River. This 2nd order stream includes three significant on-stream dams which are all located on proposed Lot 21.

The low slope areas adjacent to the central drainage depression rise to gently undulating side slopes intersected by minor drainage depressions. These areas have been significantly improved for grazing.

The westerly side slope adjacent to Sutton Road receives upslope run-on water through several road culverts which then flow through minor drainage depressions to join the central 2nd order stream.

The slope form of the areas considered suitable for effluent dispersal on Lots 1-19, is generally flat or divergent (i.e. spreading rather than concentrating flows). Areas of convergent slope form generally coincide with drainage depressions and are most often mapped within the watercourse buffers

Surface rock and outcrop Outcropping rock is limited to an area adjacent to the western boundary on proposed Lot 21. This area has a moderate 10% slope and a localised rock outcrop making it constrained for effluent dispersal.

Rocky outcrops (and associated shallow soils) are a constraint to effluent disposal, however only exist on Lot 21 which contains the existing dwelling.

Hydrology The weakly structured fine sandy to silty loam textured topsoil across the site has a moderate permeability, of 0.5 to 1.5 m/day, (table M1 of ANZ Std 1547:2012). Soil permeability combined with slope form, topography and groundcover greatly influence the amount of rainfall that becomes runoff or alternatively soaks into the soil profile to be used by evapotranspiration in plants, evaporation or moves to the groundwater system.

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

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.

The flat to low slope landscapes of the site, in conjunction with good groundcover and moderately permeable soils, contribute to lower rates of runoff and higher rates of infiltration. This is demonstrated by the general lack of sheet, rills or gully erosion across the property.

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 results in an increase in surface water runoff which can increase the erosion risk and decrease the reliability of baseflows in major creeks which are often driven by groundwater.

To reduce the impact of development on hydrology it is important to minimize the extent or footprint of disturbance and contain this within areas defined as suitable for the purpose.

Given the lot size of the proposed additional dwelling lots of 5,000m^2 and minimal additional road infrastructure to be created as a result of the subdivision, it is considered the potential for the subdivision to change local hydrology will be minimal. Furthermore, the location of the proposed additional dwelling lots are in areas of low slope and good groundcover which will help to assimilate any additional surface water runoff generated and convert this to infiltration or subsurface flows.

There are small areas of the property mapped which show signs of regional waterlogging and are constrained for effluent dispersal and dwelling construction

Areas mapped as seasonally waterlogged are constrained for effluent dispersal and dwelling construction, refer Figures 16 & 19.

Soils

Detailed soil profile descriptions from the proposed subdivision lots are provided in **Appendix 2** of this report.

The soils on the property correspond primarily to the Winnunga Soil Landscape Unit with a small area of the Gundaroo Soil Landscape Unit associated with the alluvial creek flats along the 2nd order stream (*Soil Landscapes of the Canberra 1:100,000 Sheet*. Jenkins,B. 2000).

Land which is considered suitable for effluent dispersal on the proposed building envelopes on Lots 1-20, is associated with the Winnunga Unit. The soil types are red and brown chromosols. These were formed mostly in situ on Ordovician metasediments of the Pittman formation.

Suitable soils comprise a massive to weakly structured fine sandy loam textured upper layer overlying a moderately structured red-brown coloured sandy light clay subsoil. Soil depth varies considerably but is typically greater than 100 cm, with shallower soil in the localised areas of rock outcrop.

The areas adjacent to the 2nd order stream creek coincides with Gundaroo Soil Landscape. These soils also include Bleached Red and Brown Chromosols. These soils are generally unsuited to effluent dispersal as they fall within the buffer zones from creeks and drainage depressions.

The suitable effluent dispersal areas of Red and Brown Chromosol soils of the Winnunga Unit have an adequate depth combined with 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.

CONSTRAINTS ANALYSIS

Soil erosion

The property carries good levels of groundcover across all areas which have assisted in maintaining soil stability and minimising erosion. The property is not included in the Yass Valley Local Environment Plan 2013 – Natural Resources Land Map – Sheet NRL_005 as having highly erodible land.

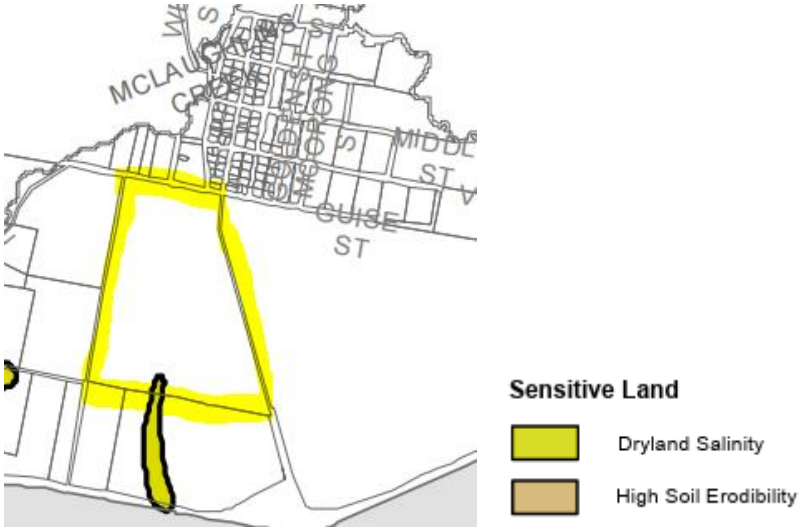

Figure 11: Yass Valley Local Environment Plan 2013 – Natural Resources Land Map – Sheet NRL_005

The soils of the Winnunga Unit, which cover most of the property, are moderately susceptible to erosion, particularly moderate to severe gully erosion where these soils coincide with drainage depressions. The low slope, flat to divergent slope form and good groundcover, have largely prevented erosion from occurring across most of the landscape. There was no major gullying, sheet or rill erosion observed, and the only minor erosion issues related to sites on the 2nd order stream as discussed below.

The major drainage depression is occupied by soils of the Gundaroo Soil Landscape Unit which are highly erodible soils with streambank and gully erosion common. This soil type is restricted to low slope riparian areas adjacent to and occupying the main drainage depression. There was only minor evidence of erosion on these soils, and this was associated with areas where stock tracks, creek crossings and dam overflows had created minor areas of active gully erosion. There was some more significant historical creek bank erosion below the wall of the dam which is situated

on the southern property boundary in Lot 21 (Dam 5). This area or erosion has largely stabilised because of upstream dam construction diverting flows around the site.

These riparian erosion issues are discussed in more detail in the Watercourse and Groundwater Assessment section of this report, general recommendations relating to these sites are included below.

Recommendations

- The two minor gully heads located on Lot 20 are associated with the overflow of the Dam 3 (last onstream structure) on Lot 21. These areas need to be stabilised by shaping and rock armouring the gully head with 150-200mm heavy ballast rock underlain by a suitable grade geotextile
- An area of minor rill/gully erosion exists on the eastern side of the main drainage depression on Lot 20 where the drainage from upslope road culverts and the overflow of a small farm dam (Dam 1 on Lot 20, possibly to be removed) enters the main stream. This area should be carefully managed through the removal of stock and allowing vegetation to regenerate and stabilise the site.
- A series of minor lateral gully heads exist in various places along the main drainage depression. These have been caused by stock tracks concentrating upslope run-off and directing this over the steep sides of the drainage depression. These areas should be carefully managed through the removal of stock and allowing vegetation to regenerate and stabilise the streambanks.

  The subdivision does not require the construction of any crossings, however if these are subsequently required they should be appropriately designed, built and maintained to reduce the risk of erosion in the sensitive riparian environment and advice should be sort from the DPI Water and Water NSW regarding the need for a controlled activity works approval.

Salinity

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 effected land is constrained for effluent dispersal as vegetation vigour is reduced therefore reducing the effectiveness of evapotranspiration in dispersing effluent; water tables are high therefore effluent may contribute to this elevated level as well as potentially contaminate groundwater; and irrigation onto bare and scalded areas is likely to convert into contaminated runoff.

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.

Dryland salinity is a significant issue in the Yass Valley Local Government area and the Yass River has been considered a priority salinity catchment within the Murray Darling Basin.

The Yass Valley Local Environment Plan recognises the significant potential for dryland salinity in the Part 6 Additional Local Provisions, Section 6.6 Salinity. This section requires that:

Before determining a development application for development on land to which this clause applies, the consent authority must consider the following:

(a) whether the development is likely to have any adverse impact on salinity processes on the land,

(b) whether salinity is likely to have an impact on the development,

(c) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

(a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or

(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

A small section of the property is included in the Yass Valley Local Environment Plan 2013 – Natural Resources Land Map – Sheet NRL_005 as having land impacted by dryland salinity, see map.

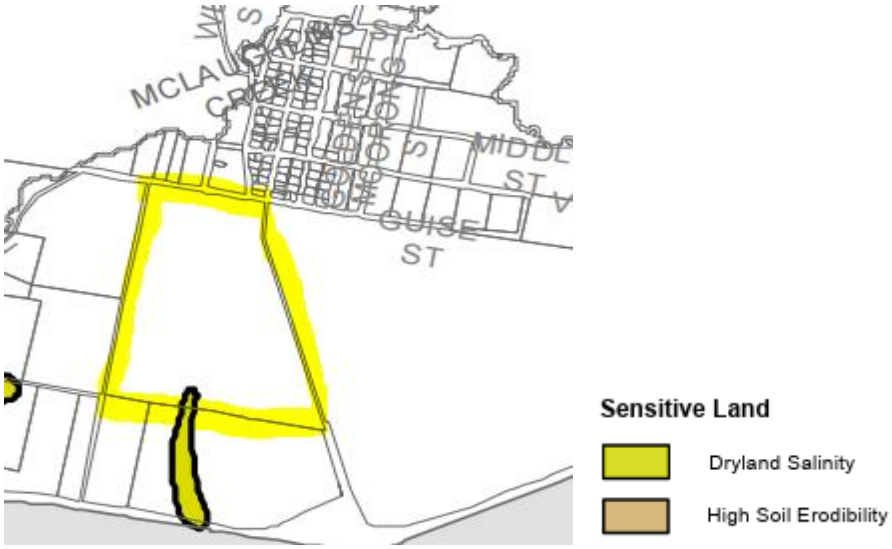

Figure 12: Yass Valley Local Environment Plan 2013 – Natural Resources Land Map – Sheet NRL_005

There was evidence of dryland salinity on the property when inspected. Signs include indicator species such as spiny rush, areas of poor pasture growth, bare scalded sites and the crusting of salts on the surface. These areas have been mapped as constrained to both effluent dispersal and dwelling construction

The separate Dryland Salinity section addresses this issue in more detail, however some general recommendations for salinity management follow:

Recommendations

- Effluent dispersal should not occur in areas mapped as salinity effected.
- Dwelling construction should not be undertaken in areas mapped as salinity effected.
- Areas mapped as salinity effected should be managed to maintain reinstate and/or manage >70% groundcover.

- The area of deep-rooted perennial pasture should be maintained as far as practical.
- Trees and shrubs should be retained and increased where possible.
- The watering practices adopted in newly created dwellings should minimise potential accessions to the shallow water table but not overwatering/irrigating.

Groundwater

The site is mapped as having Moderate groundwater vulnerability on the Department of Land and Water Conservation (2001) Groundwater Map of the Murrumbidgee Catchment.

The northern end of the site including many of the residential lots, are also mapped as groundwater vulnerable on the Riparian Lands and Watercourses Map Groundwater Vulnerability – Sheet CL2_005 in the Yass Valley Local Environment Plan 2013, refer below.

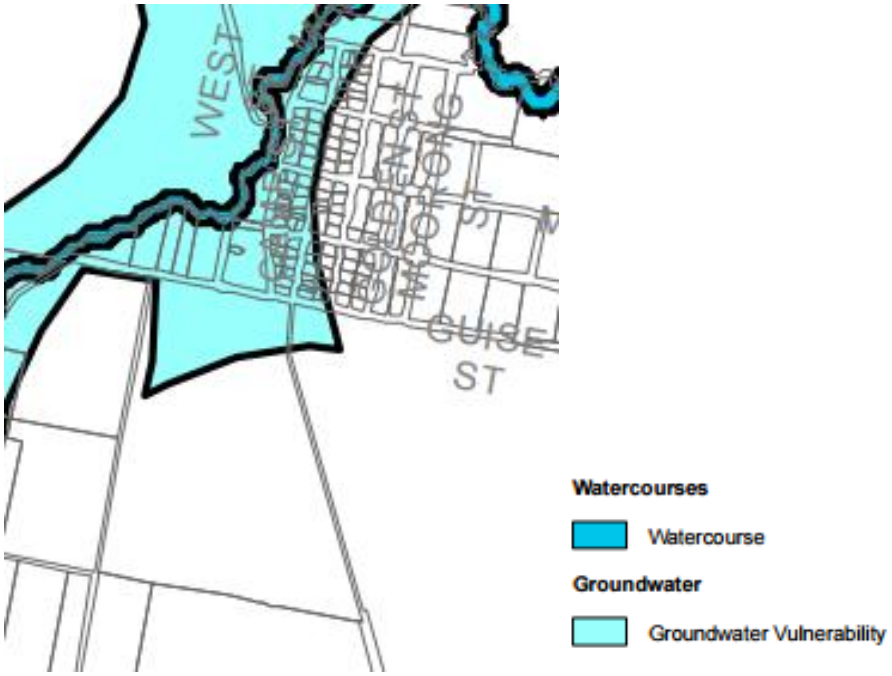

Figure 13: Yass Valley Local Environment Plan 2013 – Riparian Lands and Watercourses Map Groundwater Vulnerability – Sheet CL2_005.

As the area is mapped as groundwater vulnerable the Part 6 Additional Local Provisions 6.4 Groundwater vulnerability requires that :

Before determining a development application for development on land to which this clause applies, the consent authority must consider the following:

(a the likelihood of groundwater contamination from the development (including from any on-site storage or disposal of solid or liquid waste and chemicals),

b) any adverse impacts the development may have on groundwater dependent ecosystems,

(c) the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply),

(d) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

(a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or

(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

There are 18 bores within 500m of the low-density residential Lots 1-19. The property also has a registered bore (GW 403659) located on proposed Lot 21. The closest bore to potential effluent dispersal area is GW 401311 located 80m north of Lots 4-8. This bore is 32m deep with a non-saline yield of 0.315L/sec and a water bearing zone between 9-15m. The bore is located on the Sutton Recreation Ground and is not used for domestic purposes. Higher yielding water bearing zones / aquifers are located deeper than 27m, for example the bore on the property (GW 403659) is 54m deep with water bearing zones at 27-29m/30-33m/39-42m. This bore yields 1.5 L/sec.

Figure 14: Bore locations (NSW Water)

There is a low risk of contamination to the groundwater system, given the deep cover of low permeability clay subsoil and bedrock between areas suitable for effluent dispersal and water yielding zones; the relatively low rate of effluent application to the surface which will occur at each dwelling site; high quality advanced secondary treated and disinfected effluent and a minimum spatial separation of > 50m.

The Watercourse and Groundwater section addresses the groundwater issues in more detail however some general recommendations include:

Recommendations

- All residential Lots 1-19 will use Aerated Wastewater Treatment Systems combined with subsurface drip irrigation. This provides the quality treated effluent, and the subsurface irrigation minimises the risk of treated effluent being mobilised to contaminate nearby downslope bores.
- Maintain a minimum 50 m buffer[1] between the existing bore and any constructed bores from existing or future effluent dispersal areas.

[1] Assuming the maximum buffer distance from Groundwater recommended in the Australian Standard (AS1547:2012) is considered appropriate and conservative given the site and soil constraints are considered at the lower end of the constraint scale with category 4 & 5 soil permeability, (Table R2, pp187, AS1547:2012).

- A water supply work approval must be sought prior to constructing a bore or well even though each landholder is entitled to take water from an aquifer which is underlying their land for domestic consumption and/or stock watering without the need for a water access license under Basic Landholder Rights (the application is available at www.water.nsw.gov.au).

Riparian lands

Yass Valley Local Environment Plan 2013 does not include the 2nd order stream on the property in the Riparian Lands and Watercourses Groundwater Vulnerability Map – Sheet CL2_005, although McLaughlins Creek to the west and north is included.

NSW DPI Office of Water (Guidelines for riparian corridors on waterfront land) defines appropriate riparian buffer for various stream orders to maintain the integrity of these sensitive areas, as below:

Figure 2. The Strahler System

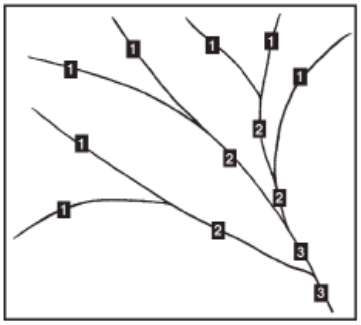

Table 1. Recommended riparian corridor (RC) widths

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 15: Stream orders (NSW DPI Office of Water)

For 2nd order streams, such as the drainage depression which flows through the centre of the property, a riparian corridor of 20 metres either side of the creek is required. The small 1st order stream which flows from the south east to join the central 2nd order stream will require a 10 metre riparian corridor. Within this corridor, built infrastructure, with the exception of approved crossings, are generally incompatible with the NSW DPI Office of Water Guidelines -this includes dwellings. These riparian corridors have been mapped as constraints to dwelling construction in **Figure 19.**

Recommendations

- No infrastructure will be constructed within the 20m riparian corridor (as mapped in **Figure 19**).
- No infrastructure will be constructed within the 10m riparian corridor (as mapped in **Figure 19**).

If any creek crossing points are required in the future for the subdivision, temporary and permanent sediment and erosion control measures will be required to ensure the integrity and stability of the creeks are maintained. This will likely require the development of an erosion and sediment control plan for NSW Water as part of the Controlled Activity Approval

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, requires appropriate buffers between drainage depressions, creeks and rivers and effluent dispersal areas. These include a 40-metre buffer between effluent dispersal areas and any water bodies including minor intermittent waterways and drainage channels, dams and culverts.

The 2nd order stream which parallels the eastern boundary of the Lots 1-19 residential area will require a 40m buffer for effluent dispersal. This may impact the location of effluent dispersal areas on Lots 4 & 14-19.

A small drainage depression which parallels the main drainage depression further to the west will require a 40m buffer for effluent dispersal. This will potentially impact effluent dispersal on Lots 1,5 & 6.

The drainage depressions below the numerous road culverts on the Sutton Road will also require 40m buffers from effluent dispersal areas. This will impact effluent dispersal on Lot 20.

Dam and drainage buffers will also influence the location of an appropriate Building Envelope on Lot 20.

The existing effluent disposal practices on Lot 21 are located outside the dam and drainage buffers located on the lot.

The dams located across the property will all require a 40m buffer from effluent dispersal which will influence the location of appropriate unconstrained Building Envelopes. All dam and drainage buffers have been mapped as constrained for effluent disposal in **Figure 16**.

Recommendations

- The land designated for effluent dispersal on proposed Lots 1-21 will require a minimum 40m buffer distance off all drainage depressions mapped in **Figure 16.**
- The land designated for effluent dispersal on proposed Lots 1-21 will require a minimum 40m buffer distance from all dams mapped in **Figure 16.**

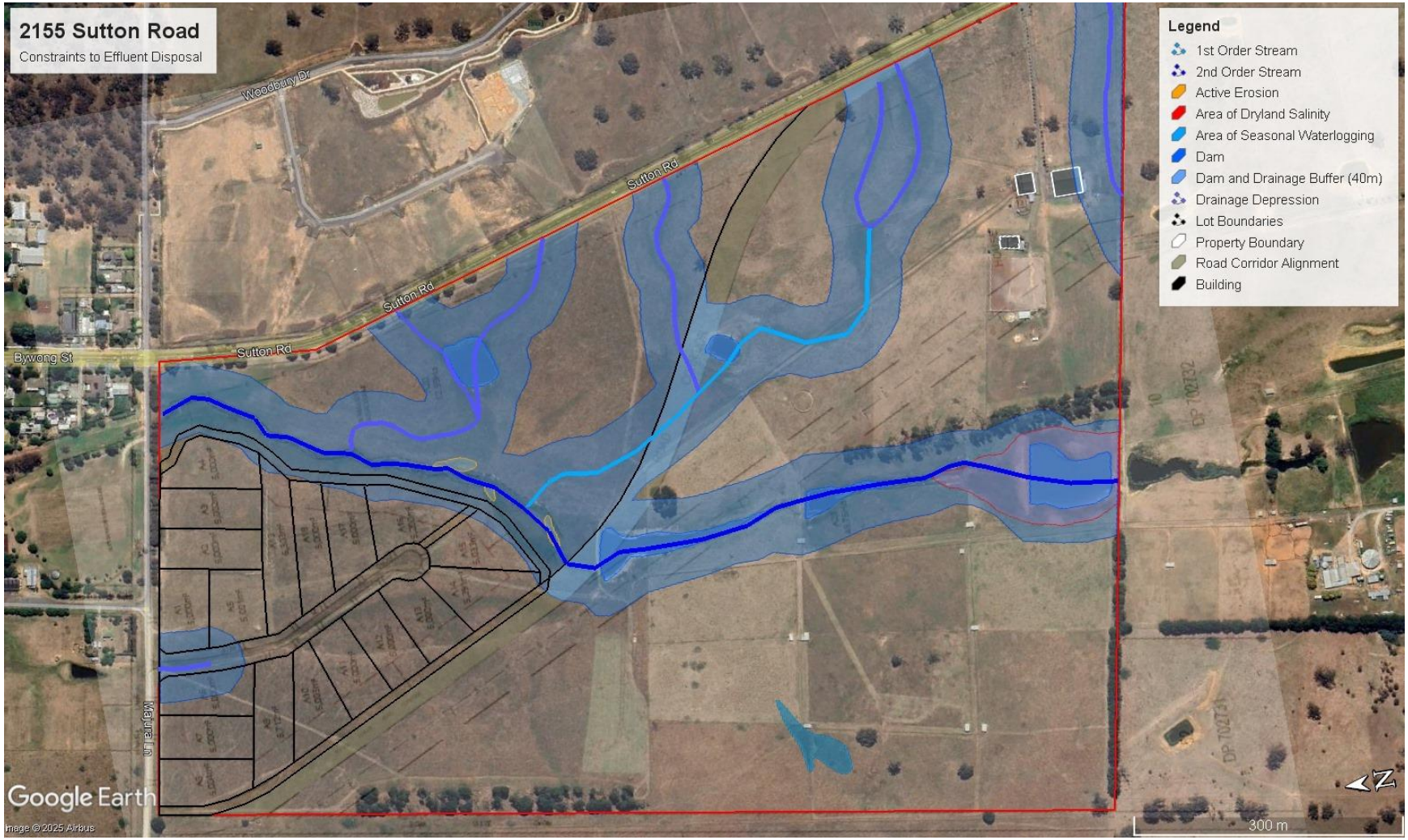

Figure 16: Constraints to Effluent Dispersal – dam and drainage buffers, erosion, salinity and seasonal waterlogging.

MANAGEMENT OF EFFLUENT

Summary

This report assesses the general availability of adequately sized areas of land which are well drained, gently sloping and with moderately deep soil cover and suitable site conditions for the dispersal of effluent on the proposed new dwelling lots, Lots 1-20 (excluding Lot 21 with the existing dwelling).

For all sites, a minimum area of 1,300 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 550 m^2, but accounts for the requirement to have a reserve area, plus allows for buffers from buildings, boundaries and driveways.

The constraints analysis has identified the level of constraint to effluent disposal attributable to each proposed lot as follows:

- LOW – few constraints to onsite effluent dispersal and achievable by careful location of Building Envelope
- MODERATE – significant constraints to onsite effluent dispersal which significantly limit the area available for Building Envelope on the lot and/or require specialized treatment and disposal systems
- HIGH – major constraints to effluent dispersal which require major modifications to lot size, shape, location.

For the low and moderate constraints, some modification strategies are suggested. No lots are highly constrained.

Table 1: Constraints Analysis

Lot Number(s)	Constraint Level	Possible Modifications
2, 3 & 7-14	None	No modifications required
21	Low-drainage buffers, seasonal waterlogging, salinity.	Existing dwelling - no modifications required.
1,5 & 6	Low- drainage buffers, seasonal waterlogging.	Effluent disposal practices and dwelling construction to occur outside drainage buffers and areas of seasonal waterlogging.
4,15-19	Low-drainage buffers.	Locate Building Envelope and effluent disposal practices outside drainage buffers
20	Moderate-drainage buffers, erosion, seasonal waterlogging.	Locate Building Envelope and effluent disposal practices outside drainage buffers, areas of erosion and seasonal waterlogging.

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 or shallow subsoil. Reliability and maintenance issues with such systems are well known and the risk of failure is relatively low.

Advanced aerated wastewater treatment systems include an additional level of treatment to further reduce contaminants, particularly Nitrogen and Phosphorous levels. These systems are particularly useful in sensitive areas and where the effluent irrigation area needs to be reduced to the smallest footprint possible.

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 best suited to subsoil absorption of primary treated effluent due to the lower permeability light clay subsoils and proximity to sensitive vulnerable groundwater receiving environment associated with Sutton village.

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 of effluent management will occur at the time of submitting building plans to council at which 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 in this report

Secondary treatment 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. Significant improvement in effluent dispersal can be achieved 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 currently common 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.....325m^2

Four bedrooms.....400m^2

Five bedrooms.....475m^2

Six bedrooms.....550m^2

Council also requires adequate suitable land for a reserve effluent dispersal area. Additionally, buffers with the boundary are required. *The Silver Book* prescribes 6 m from a downslope boundary and 3 m with a cross or upslope boundary.

Hence, a conservative minimum area of suitable land for each lot is 1,300m^2.

Secondary Treatment and subsurface drip irrigation

NSW Health accredited systems treat effluent to a secondary standard, suitable for disposal by surface or subsurface irrigation (see list at http://www.health.nsw.gov.au/PublicHealth/environment/water/wastewater.asp).

The sizing of the effluent irrigation area is based on nutrient balance and the size required. A significant reduction in the risk associated with potential offsite movement of treated effluent downslope can be achieved by disposing of treated effluent through subsoil drip irrigation.

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. The type of AWTS treatment system used will also vary the area required for effluent irrigation.

Council also requires adequate suitable land for a reserve effluent dispersal area. Additionally, buffers with the boundary are required. *The Silver Book* prescribes 6 m from a downslope boundary and 3 m with a cross or upslope boundary.

An approximate area of 1,300m^2 of unconstrained land is required for effluent disposal associated with up to a 6-bedroom dwelling and using a standard AWTS system. This area allows for an effluent

irrigation area of 550m^2 plus and equal size reserve area and some allowance for buffers from boundaries and buildings.

Primary treatment and subsoil absorption

Not generally suitable due limitations of low soil permeability at depth with light clay subsoils and vulnerable down gradient groundwater environment underlying Sutton village and surrounds.

Innovative effluent management systems

A Wisconsin mound pump dosed from a septic tank would be well suited to the particular 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 150m^2 on a flat or gently sloping site.

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 Lots 1-20, and the prescriptions of this report should be applied to the respective lot.
- Lots 1-19 should be required to install secondary treatment systems (AWTS) combined with subsurface drip irrigation, to minimise the impact on vulnerable groundwater systems in the area.
- Lot 20 should be required to install secondary treatment systems, (AWTS or other NSW Health accredited system) with effluent disposal through surface spray or drip, or subsurface drip irrigation.
- Buffers to be applied to effluent dispersal areas will include:
  - 40m from dams and drainage depressions as mapped
  - 50 m from the bore GW 401311
  - 6 m with downslope lot boundaries
  - 3 m with cross slope and upslope boundaries
  - 15 m from dwellings and other buildings
- The irrigation area size should be based on daily effluent load based on potential occupancy derived from bedroom number, combined with

site and soil constraint assessment as detailed in the *site and soil assessment for on-site effluent management* developed for each lot.

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

Existing Management System

The existing dwelling located on Lot 21 will continue to operate the existing effluent management system in accordance with Council operating conditions.

CAPABILILTY FOR DWELLING CONSTRUCTION

Summary

This study has adopted a slope grade of 15% as the threshold above which building envelopes should not be located, this is consistent with many building codes and Council requirements. This cutoff is also considered appropriate for the land covered by this proposal as it corresponds to the slope grade above which erosion hazard increases from low to moderate (Landcom, 2004). There were no areas of slope in excess of 15% identified on the site. The proposed new dwelling lots are all located on flat to gently undulating land with less than 8% slope.

Land which is prone to seasonal waterlogging or flood flows (including the minor 1st and 2nd order streams and drainage depressions which drain the site), salt affected land and areas of active erosion are all excluded from land suitable for dwelling construction. These areas are mapped in **Figure 19** and generally do not occur in the area proposed for residential dwelling lots except for a minor area of seasonal waterlogging on Lot 6 and some intersection of flood prone land on Lots 2-3 & 15-19.

In addition, under NSW DPI Office of Water (Guidelines for riparian corridors on waterfront land) the 2nd order stream requires a 20m buffer and the 1st order stream (which joins the 2nd order stream in the middle of the property), requires a 10m buffer either side of the channel.

Dwelling construction within these buffer areas would be inconsistent with NSW DPI Office of Water policy and should therefore be considered as unsuitable for dwelling construction. These riparian corridors are mapped in **Figure 19** and generally do not occur in the area proposed for dwelling lots. The riparian corridors also correspond closely with the area mapped as flood risk and

The 40m buffer on drainage lines and around dams required for effluent disposal areas, do not apply for dwelling construction.

The remaining gently sloping, free draining land can be considered suitable for dwelling construction without threatening soil stability

Flood Levels in 1 in 100 Year Flood Event

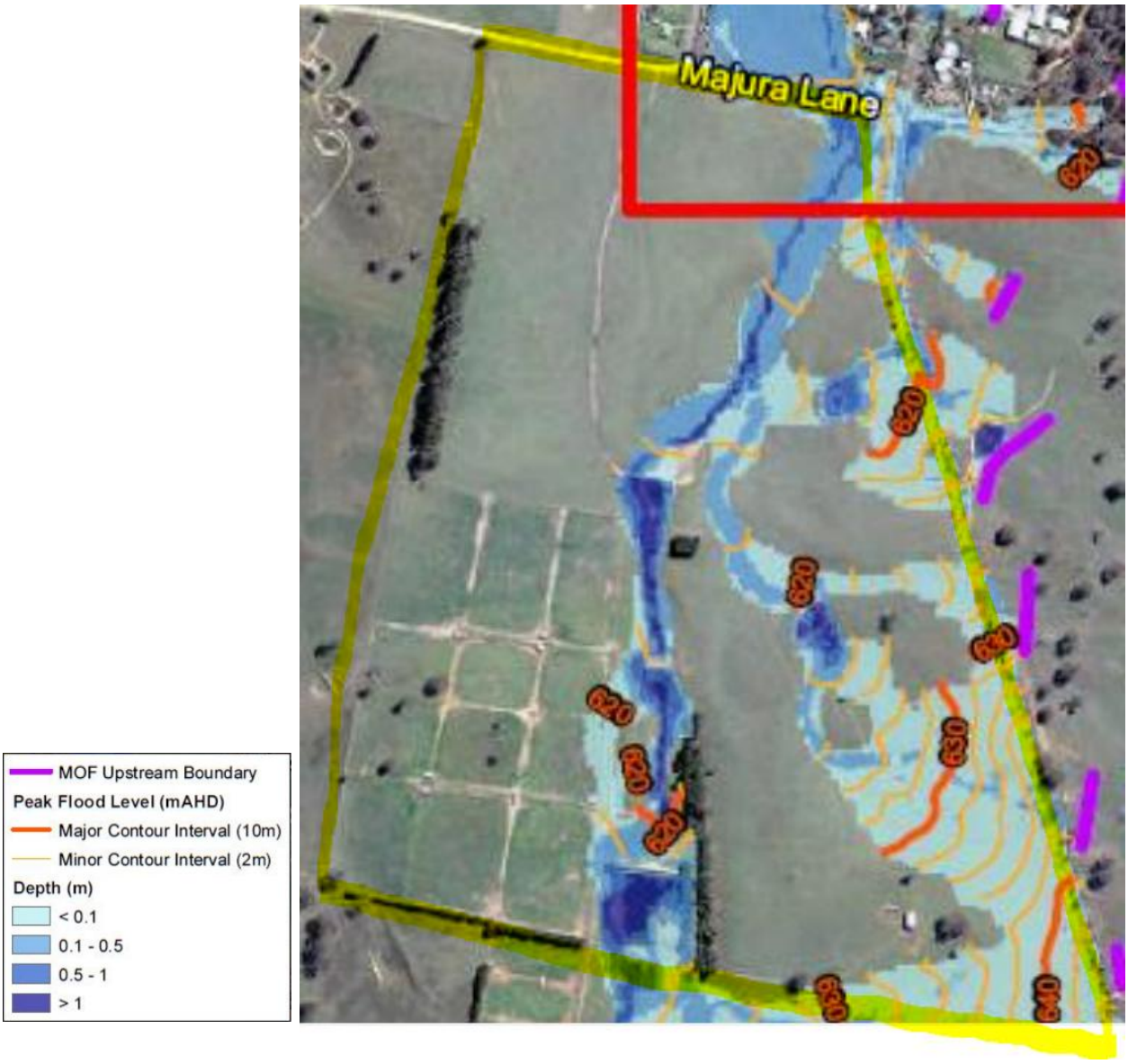

Figure 17: Flood levels (Sutton Floodplain Risk Management Study & Plan)

Flood Risk Zones

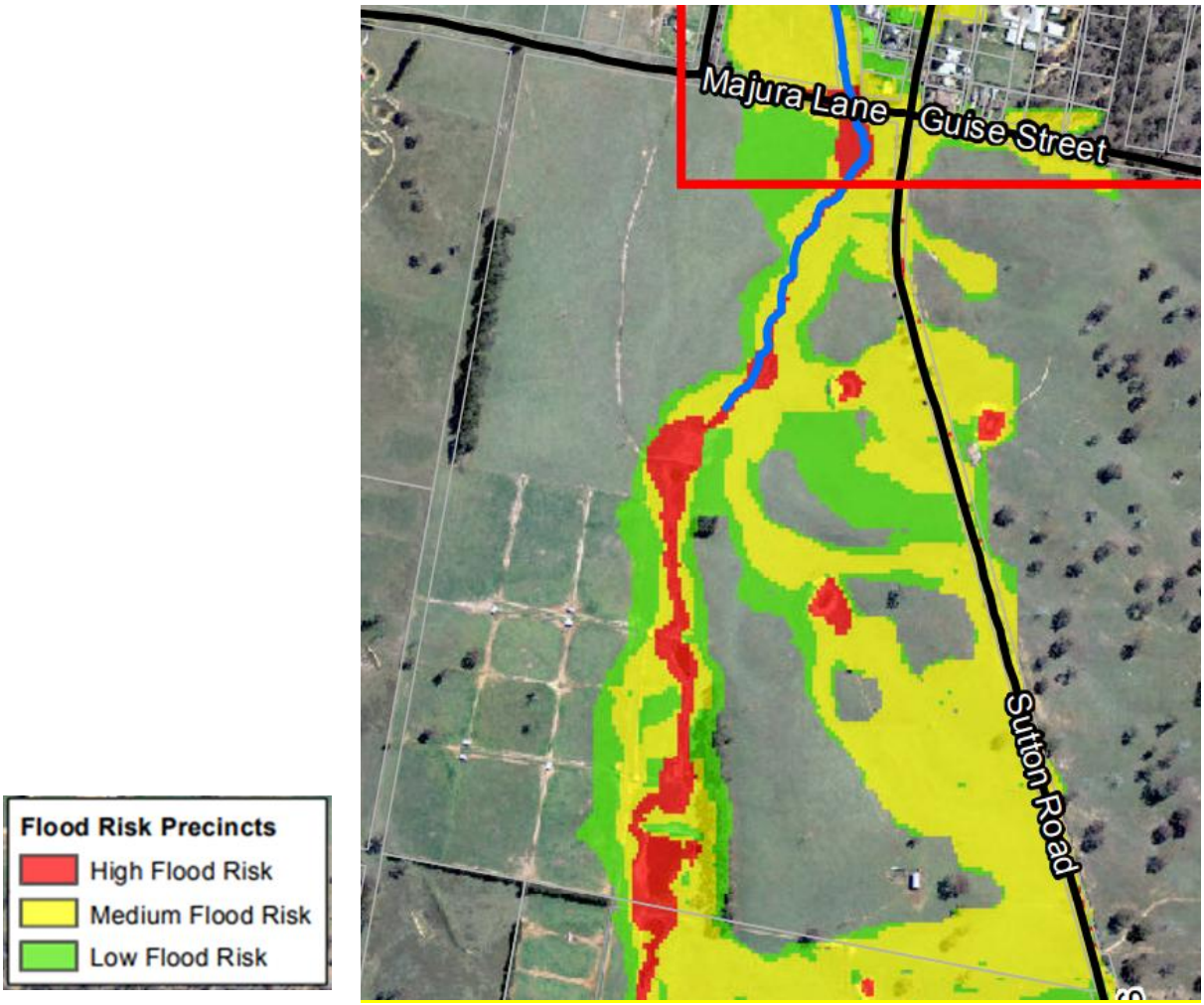

Figure 18: Flood risk zones

Dwelling Construction

Recommendations

Building envelopes will be restricted to land shown in this report as suitable, based on excluding areas of land which are affected by dryland salinity, seasonal waterlogging, flooding, active erosion or within the 20m riparian corridor of the 2nd order stream or the 10m riparian corridors identified for the 1st order stream (refer **Figure 19**).

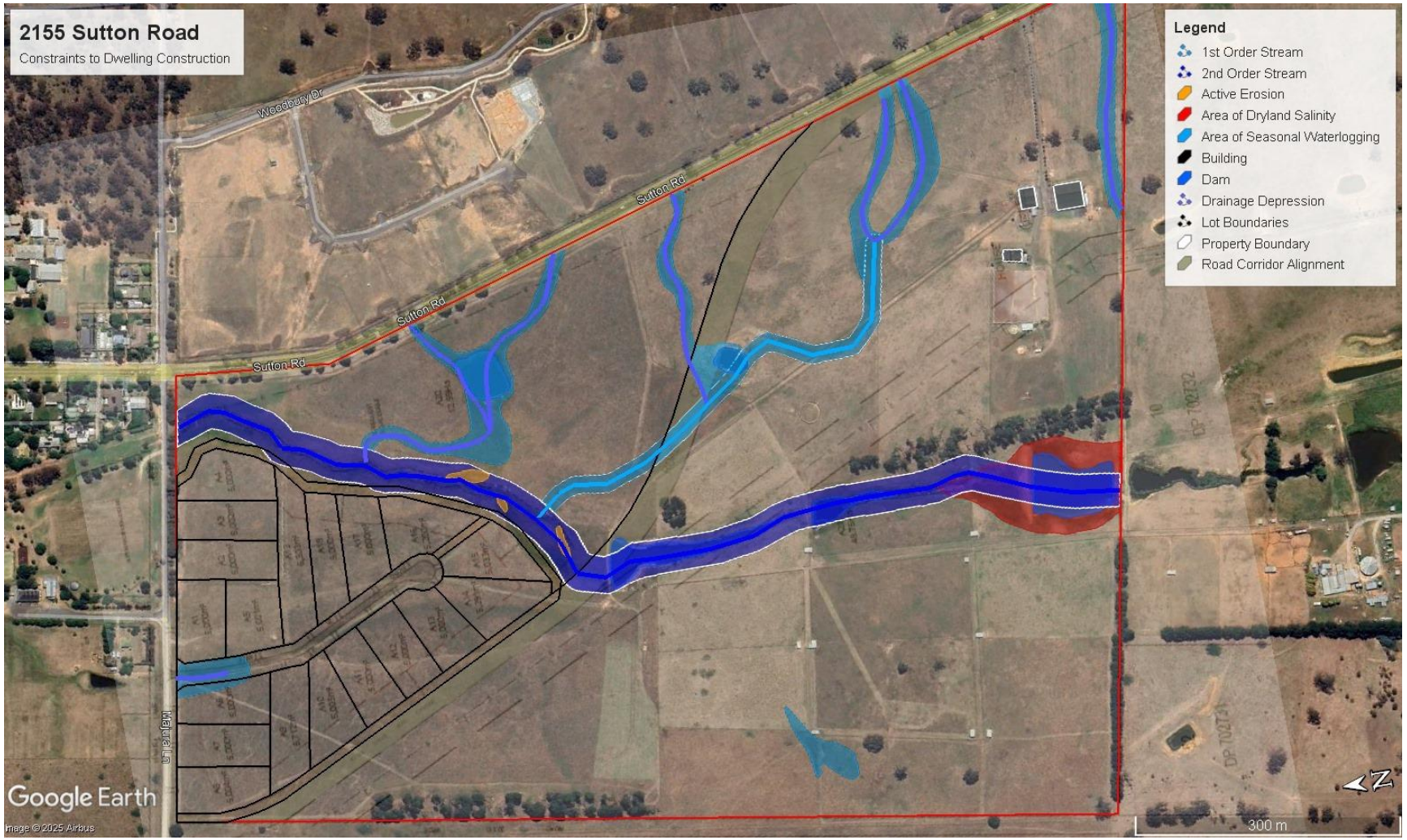

Figure 19: Constraints to dwelling and infrastructure construction (buffers locations shown are approximate).

RIPARIAN AND GROUNDWATER ASSESSMENT

Soil and Water undertook an assessment of the potential impacts to watercourses and groundwater aquifers associated with the property. The assessment focused on the specific considerations in *Additional Local Provisions* in *Part 6 of the Yass Valley Local Environment Plan 2013,* specifically *Part 6.4 Groundwater vulnerability* and *Part 6.5 Riparian land and watercourses*. These include:

1. *Groundwater impacts including:*
    1. *the likelihood of groundwater contamination from the development*
    2. *any adverse impacts the development may have on groundwater dependent ecosystems*
    3. *the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply)*
    4. *any appropriate measures proposed to avoid, minimise or mitigate the development.*

2. *Riparian land and watercourse impacts to:*
    1. *water quality and water flow*
    2. *aquatic and riparian species, habitats and ecosystems of the watercourse*
    3. *the stability of the beds and banks of the watercourse*
    4. *the free passage of fish and other aquatic organisms within or along the watercourse*
    5. *any future rehabilitation of the watercourse and riparian areas*
    6. *the volume of water to be extracted from the watercourse*
    7. *any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development*

Potential issues relating to post-subdivision ground or surface water licensing, are also discussed.

RIPARIAN IMPACT ASSESSMENT

The 2nd order stream which flows centrally through the property is not mapped on the Riparian Lands and Watercourses Groundwater Vulnerability Map – Sheet CL2_005 in the *Yass Valley Local Environment Plan 2013*. Nonetheless it is considered useful to use the *Part 6.5 Riparian land and watercourses* issues in the LEP to frame the assessment. Accordingly the entire reach of the 2nd order stream was inspected for any issues with potential to impact:

i. water quality and water flow
ii. aquatic and riparian species, habitats and ecosystems of the watercourse
iii. the stability of the beds and banks of the watercourse
iv. the free passage of fish and other aquatic organisms within or along the watercourse
v. any future rehabilitation of the watercourse and riparian areas
vi. the volume of water to be extracted from the watercourse
vii. any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

The results of this riparian assessment, including recommendations, are summarised below.

The only issue not addressed by the recommendations below is the volume of water to be extracted from the watercourse. This is addressed in the Water Licensing and Approvals Implications section which follows the Groundwater Assessment.

Dryland Salinity

An extensive area in and around Dam 5 (refer **Figure 20**) is affected by dryland salinity. The area is a saline discharge site where the saline groundwater table meets the surface and discharges. The effect of this saline groundwater discharge is to limit pasture growth and as salts accumulate in surface soils through evaporation, soil salinity levels increase to the point that normal pasture and grass species cannot survive and eventually die out. This leaves a bare area referred to as a saline scald which, due to the location in the riparian zone, is very prone to erosion. This process is occurring in and around Dam 5, refer below:

Figure 20: Scalded areas immediately upslope of Dam 5 (neighboring property).

The construction of large dams in areas of high saline groundwater tables can increase the pressure on groundwater systems exacerbating discharge immediately around the dam top water level.

Figure 21: Dam 5 showing signs of saline discharge in and around top water level.

The area immediately below Dam 5 and above the back up of Dam 4 is an area of previous erosion which was most likely partly caused by salinity and the related reduced groundcover. This area is largely stabilised however is still vulnerable to erosion and is still effected by salinity, refer below:

Figure 22: Below Dam 5 showing salty crust on bare eroded earth.

Recommendations:

- The area around Dam 5 and below the wall which is mapped as salinity effected should be fenced out from stock to ensure groundcover is maintained and saline scalding is minimised. Stock can be periodically introduced to the fenced-out area to crash graze and reduce the vegetation levels to prevent them from becoming rank.

Section between dams 5, 4 & 3

This area is a generally stable riparian with good groundcover and a dense growth of aquatic species such as Cumbungi, refer below

Figure 23: Back up of Dam 4 with dense Cumbungi growth.

The growth of Cumbingi assist in stabilizing creek banks however it can become so dense as to restrict flows in the stream, increase flood risk and create erosion through the diversion of flows.

Recommendations:

- Monitor growth of Cumbingi and control to ensure there is an adequate clear area in the central channel for unrestricted flows.

Area of active erosion

There are three areas of minor gully erosion along the 2nd order stream. The two most active gully heads are associated with the overflow of Dam 3.

Figure 24: Eroding overflow of Dam 3.

Figure 25: Eroding overflow of Dam 3.

These small active gully heads will continue to erode each time the stream flows and Dam 3 overflows.

Recommendations:

- Reshape the gully head and face with loose heavy ballast rock of 150-20mm diameter on an underlay of geotextile fabric to create a batter grade/ramp of 1 in 10 or flatter. Manage grazing activities to maintain groundcover.

Reach below Dam 3 wall to Guise Street boundary

Generally stable riparian zone with good groundcover of introduced species on gently graded banks, refer below:

Figure 26: Well vegetated stable creek banks

There is some evidence of saline groundwater discharge into the base and side of the creek. These areas can be popular with stock that use the saline soil as a salt lick and can create bare erosion prone areas as a result, refer below:

Figure 27: Saline discharge on stream bank being disturbed by stock

There are numerous areas where stock tracking down the stream bank is generating small lateral gully heads. These areas will continue to expand slowly with each rainfall runoff event, refer below:

Figure 28: Stock track concentrating flow and creating an active gully head.

Recommendations:

- The streambank from below Dam 3 wall to the Guise Street boundary should be fenced off from stock to manage grazing pressure and maintain the stability of the creek banks. Stock can be periodically introduced to the fenced-out area to crash graze and reduce the vegetation levels to prevent them from becoming rank.

GROUNDWATER IMPACT ASSESSMENT

The potential impact of the development on groundwater has been assessed in relation to the specific heads of consideration as contained in the Yass Valley Local Environment Plan 2013.

i. the likelihood of groundwater contamination from the development

There is minimal chance of contamination of groundwater resulting from the development due to:

- intensity of development is low with the creation of a maximum of 20 additional dwelling lots over a land parcel of 73 hectares;
- new effluent management systems in the low density residential area which partially overlaps the area mapped as groundwater vulnerable, will be secondary treatment systems (AWTS) which will reduce the level of contaminants in treated effluent;
- the existing effluent management system will be unchanged;
- the closest bore is located on the Sutton Recreation Ground and is not used for domestic purposes;
- effluent generated by AWTS systems will be dispersed through subsurface drip irrigation which will minimise the potential for downslope movement of treated effluent offsite. This will minimise the groundwater contamination risk which is highest where treated effluent is mobilised and moves downslope to meet the casing of existing bores and travels down the outside of the casing to water bearing zones;
- the maximum buffer distance of 50 metres between effluent dispersal and bores recommended in the Australian Standard (AS 1547:2012) will be maintained;
- soils on the site are permeability category 4 & 5 which are a low groundwater related constraint to effluent disposal (refer AS 1547:2012);
- rate of effluent application will be low and application to the surface will maximise plant effluent use through evapotranspiration;
- transmissivity of fractured rock aquifer systems is low and depth to shallow low yielding water bearing zones is >9 m and higher yielding zones >25 m.

ii. any adverse impacts the development may have on groundwater dependent ecosystems

There will be minimal risk to groundwater dependent species and ecosystems as the overall impact to the groundwater system through contamination or increased extraction will be negligible. There are no strongly groundwater dependent ecosystems known in the vicinity.

iii. the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply)

There is currently only one Domestic and Stock bore located on the property which is located on proposed Lot 21. Newly created lots will be entitled to access groundwater under the Basic Landholder Rights (BLR) provisions of water legislation, a works approval will be required prior to bore construction. It is considered that there is low potential for a significant increase in the number of bores associated with the development due to the associated capital and operating costs, and the limited capacity for lots to achieve the necessary 250m buffer distance from effluent disposal practices. The limited number of lots who could meet the buffer distance requirements would be the larger Lot 21 who would possibly extract groundwater for Stock and Domestic watering purposes, therefore volumes would be minimal.

Any bores for irrigation purposes would require licensing, at which stage the sustainability, including the potential cumulative impact on the aquifer and surrounding bores, will be assessed by NSW Water.

iv. any appropriate measures proposed to avoid, minimise or mitigate the development.

The primary measure proposed to minimise the potential for the development to impact groundwater include:

- require that all residential lots (Lots 1-19) install secondary treatment systems (AWTS) linked to subsurface drip irrigation to minimise the risk to the groundwater system and surrounding bores
- maintain a minimum 50 m buffer between effluent dispersal areas and any existing or proposed bores.

WATER LICENSING AND APPROVALS IMPLICATIONS

This report has examined the existing non-potable water infrastructure to determine what if any actions may be required to comply with relevant legislation post development and what management restrictions may be placed on the future use of existing infrastructure.
There are a total of 5 dams installed on the property including two significant size structures. Three of these structures (Dams 2,3,4 & 5) are located on proposed Lot 21 whilst Dam 1 is located on Lot 20. All existing dams are used for Domestic and Stock purposes.

Once the site is developed these water storages will need to comply with current controls under the Water Management Act (2000). This requires that the volume of any farm dams does not exceed the Harvestable Right (HR) of the Lot. The HR is the water storage volume (Ml) which can be retained without the need for a licence and used on the Lot for any purpose. The HR is calculated by multiplying the lot size (ha) X 0.07Ml/ha (the HR factor for the region). Any water storage which exceeds the HR for the Lot will need to be modified or removed to meet the HR or a surface water entitlement is purchased to cover the volume in excess of the HR.
There are exceptions to the need to comply with the HR for newly created Lots where the water storages were constructed for erosion control purposes.
The below table identifies the relevant attributes of each water storage to determine what if any follow up action may be required to regularise these storages post development:

Table 2: Dam Assessment

Dam Number	Stream classification	Dam surface area (m^2)	Depth (m)	Estimated volume (m^3)	Dam function (main function first)	Constructed[2]	Exempt
1	Drainage Depression	815	3.5	1141	Stock Water	Pre 1999	No
2	1st	1078	4.5	1940	Stock Water	Pre 1999	No
3	2nd	2061	5.0	6185	Stock Water/Erosion	Pre 1999	To Be Confirmed (TBC)
4	2nd	1050	4	1470	Stock Water/Erosion	Pre 1999	TBC
5	2nd	4880	8	13664	Stock Water/Erosion	Pre 1999	TBC
Total				**24.4 ML**			
Maximum Harvestable Right Dam Capacity				**5.11 ML**			

[2] This was assessed using historical aerial imagery which dates back to 2002, then determining that the structures were well vegetated and established at that stage therefore existed prior to 1999, refer **Figure 10**.

Table 3: Lot Audit

Lot Number	Size	Harvestable Right (ML)	Dam Volume (ML)	Exempt	Balance	Action Required[3]
20	12.99	0.909	1.141	TBC (Dam 1)	0.232	• Confirm follow up action required
21	48.75	3.4125	1.94 6.185 1.47 13.664 **23.259**	TBC (Dam 3,4 & 5)	19.8465	• Confirm exempt status of Dams 3,4&5 • Confirm follow up action required

Based on the assessment of the existing farm dams located on the property and the proposed lot sizes, the following actions are recommended:

- Confirm whether Dam 2 is to be removed to facilitate the future construction of the Sutton Bypass road.
- Confirm whether Dams 3,4 & 5 which are considered to serve some erosion control function, are to be considered as exempt for the purpose of determining the Harvestable Right for each lot.
- Confirm any follow up actions required by Water NSW to comply with relevant legislation.

The existing Domestic and Stock bore located on Lot 21 is a registered (GW 403659) and licensed for Stock and Domestic use (40BL190836). Provided the use of this bore does not change there is no need for action following subdivision.

The proponent will undertake whatever actions are determined necessary to comply with relevant legislation. This may include the removal and / or modification of existing dam structures and/or the purchasing of existing surface water licenses to cover any volumes (or part thereof) determined to be in excess of the Harvestable Right attributable to the newly created lots.

[3] This was assessed using historical aerial imagery which dates back to 2002, then determining that the structures were well vegetated and established at that stage therefore existed prior to 1999, refer **Figure 10**.

Figure 29: Dam Construction Date Assessment

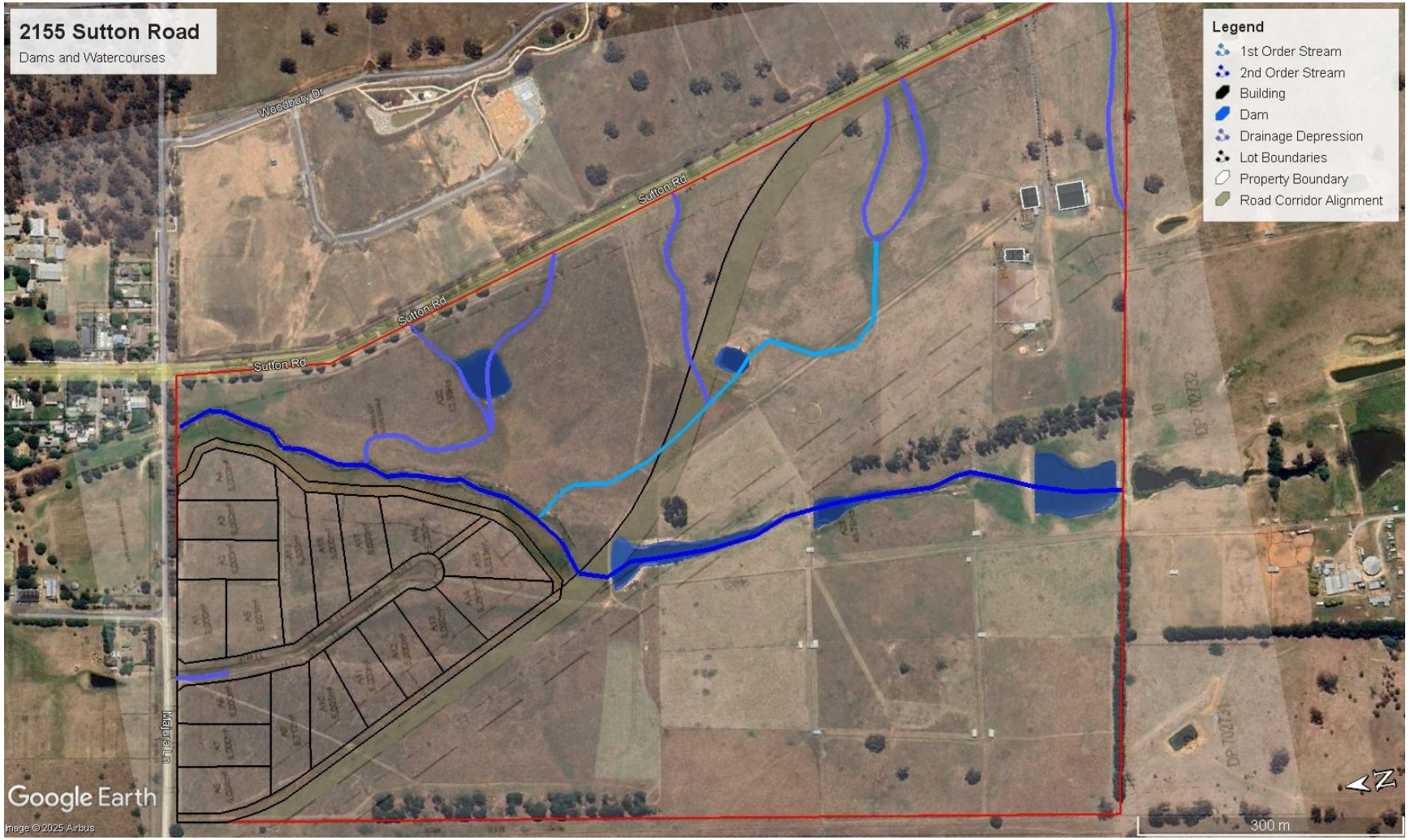

Figure 30: Watercourse and Dam Assessment

DRYLAND SALINITY

Soil and Water undertook an assessment of the impacts of dryland salinity on the property and the potential for the subdivision to increase or exacerbate dryland salinity in the area.

The potential impact of the development on dryland salinity has been assessed in relation to the specific heads of consideration as contained in the *Yass Valley Local Environment Plan 2013*.

(a) whether the development is likely to have any adverse impact on salinity processes on the land,

The development is considered unlikely to have an adverse impact on salinity as there will be negligible additional accessions to the saline groundwater system or any exacerbation of salinity related scalding or erosion, provided the development adopts the recommendations included in this report which include:

- no effluent disposal in areas impacted by salinity (as mapped)
- areas mapped as salinity effected should be managed (stock access) to maintain reinstate and/or manage >70% groundcover
- the area of deep rooted perennial pasture should be maintained as far as practical particularly in areas mapped as Moderate Recharge, refer **Figure 31** in this section
- trees and shrubs should be retained and increased where possible particularly in areas mapped as Moderate Recharge, refer **Figure 31** in this section
- irrigation of domestic gardens and lawns should be managed to minimise accessions to the groundwater table.

(b) whether salinity is likely to have an impact on the development,

Salinity will not adversely impact on the development because built infrastructure is proposed for a limited area of the property located away from the localised occurrences of salinity. Effluent management practices are generally located adjacent to dwelling infrastructure and therefore also remote form the salinity areas. Therefore, salinity will not impact on the development provided the recommendations included in this report are adopted, which include:

- no development of dwellings in areas impacted by salinity (as mapped)
- no effluent disposal in areas impacted by salinity (as mapped).

(c) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

A range of recommendations have been included in this report which will avoid, minimise and mitigate the impacts of the development on salinity. These include:

- reducing accessions to the saline groundwater table by avoiding effluent irrigation in areas of high water table and/or saline discharge

- encouraging water wise domestic irrigation practices to reduce accessions to the saline groundwater table
- maintain the area of deep rooted perennial vegetation to reduce accessions to the saline groundwater table, particularly in moderate recharge areas
- encouraging an increased area under trees and shrubs, particularly in moderate recharge areas
- fencing of salinity affected areas to manage stock access and minimise the risk of exacerbating salinity related erosion.

Figure 31: Dryland Salinity

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
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Restricts plant growth

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
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: Proposed Lot 15

Soil classification	Depth (cm)	Properties
Red Brown Chromosol	0-10	A1 medium brown fine sandy-silty loam, no coarse fragments, weak structure, dry and friable consistence, gradational colour change to
	10-40	A2 bleached light brown fine sandy-silty loam, no coarse fragments, weak structure, dry and friable consistence, gradational colour and textural boundary to
	40->100	B red / brown sandy light clay, 5% coarse fragments, moderate structure, dry and friable consistence, continues.

Soil profile augered at representative site in area suitable for effluent dispersal, refer **Figure 32**.

Soil Profile 2: Proposed Lot 9

Soil classification	Depth (cm)	Properties
Red Brown Chromosol	0-10 10-30 30->100	A1 medium brown fine sandy-silty loam, no coarse fragments, weak structure, dry and friable consistence, gradational colour change to A2 bleached light brown fine sandy-silty loam, no coarse fragments, weak structure, dry and friable consistence, gradational colour and textural boundary to B red / brown sandy light clay, 5% coarse fragments, moderate structure, dry and friable consistence, continues.

Soil profile augered at representative site in area suitable for effluent disposal, refer **Figure 32**.

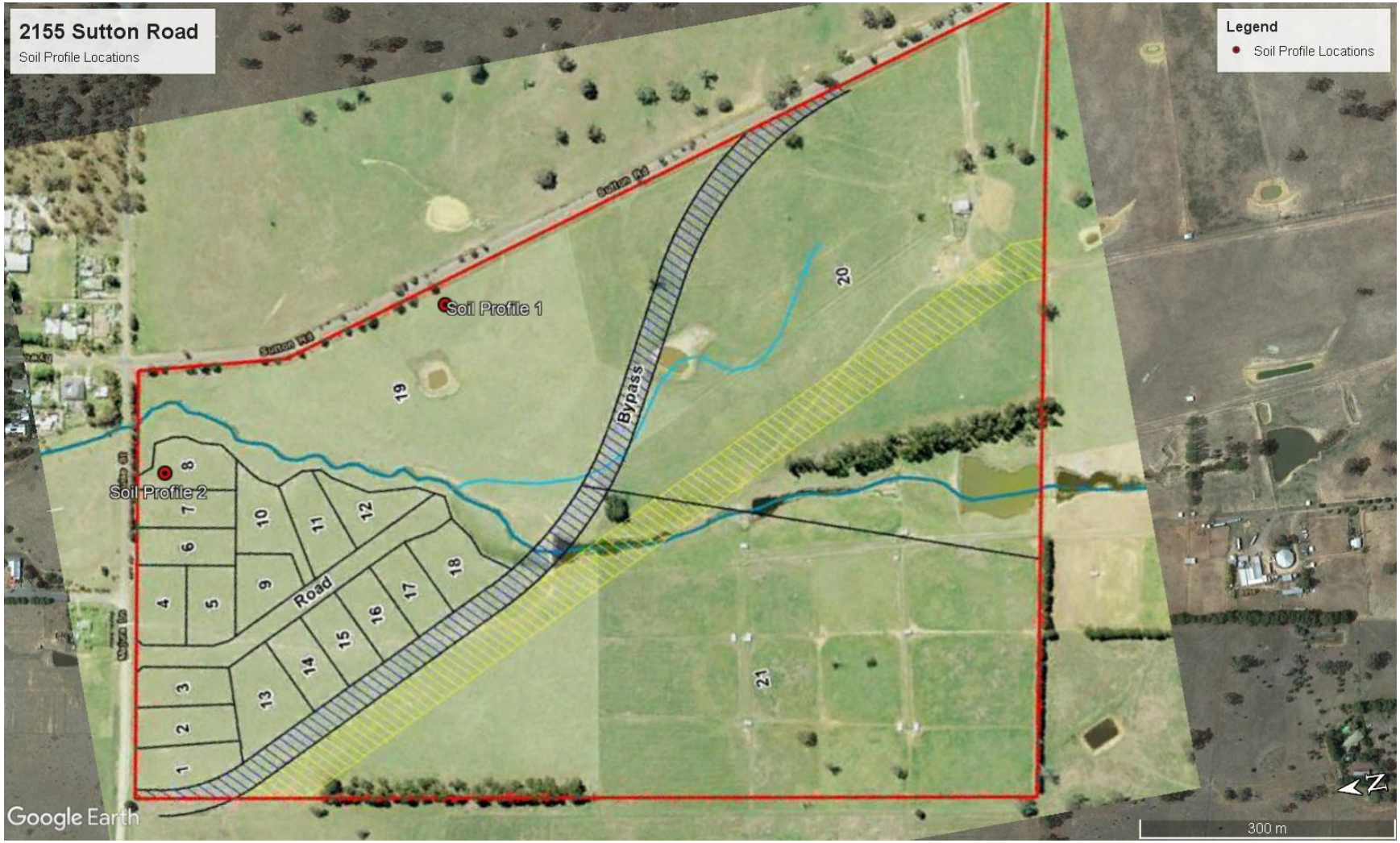

Figure 32: Soil Profile Locations – NB: subdivision layout is from previous report – no new soil profiles have been excavated.

Appendix 3: Effluent Area Design

Water balance	Using the same DIR for spray irrigation on clay loam soils of 3.5 mm/day and adopting the most conservative (i.e. largest) estimate of additional design loading of 720 L/day, the following land application areas are required to manage additional hydraulic loading, nitrogen and phosphorous generated: • **Sizing based on hydraulic loading:** A = Q (l/day)/DIR (mm/day) where A = area; Q = 720 l/day; DIR = 3.5 mm/day A = 720/3.5 = 206 m^2 **Area required = 206 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 = 720 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 = 720 X 20 X 365/15,000 = 350m^2 **Area required = 350 m2**
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 720 X 365 X 50 = 131.4kg P_{uptake} = 4.4mg/m^2/day X 365 X 50 = .080kg/m^2 P_{sorb} = 2250kg/ha = .225kg/m^2 A = 131.4/(.08+ .225) = 481 m^2 **Area required = 431 m^2**
Design effluent disposal area	Therefore, a land application area of approximately **450 m^2** will account for phosphorous, nitrogen and water applied based on estimated connections and usage patterns associated with the construction of a 5-bedroom house. An allowance of a reserve land application area will double this area to **900m^2**. Allowing for up to a 6 bedroom houses (7 occupants) and buffer distances from Lot boundaries, buildings and other infrastructure a typical effluent disposal area of **1,300m^2** has been adopted for the purposes of this assessment.

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