Attachment 7 - Groundwater Impact Assessment

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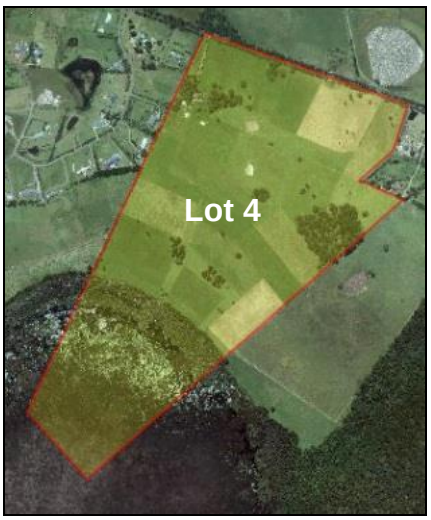
GROUNDWATER IMPACT ASSESSMENT

Part Lot 4 in DP834254
510 Beach Road Berry

for

E. Hall



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E. Hall (1)

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1. INTRODUCTION AND BACKGROUND

As requested by *E. Hall* (the owner), *Larry Cook Consulting Pty Ltd* has undertaken a site inspection and carried out an assessment of potential impacts on the shallow groundwater system from proposed on-site wastewater (effluent) disposal on Part Lot 4 in DP834254 No. 510 Beach Road Berry South Coast New South Wales (the Site). The Site is shown on a lot plan in **Figure 1** and on a topographic plan presented in **Figure 2**. A plan of the Site supplied by *Strategic Environmental & Engineering Consulting* (SEEC) is presented in **Figure 3**.

It is understood that the owner proposes to rezone part of the Site from RU1 (Primary Production) to R5 (Large Lot Residential). In this regard, Shoalhaven City Council (Council) requires an assessment of on-site disposal of treated wastewater on shallow groundwater systems that may be present on the Site. It is understood that SEEC has prepared a conceptual Water Cycle Management Study (WCMS) that incorporates a conceptual design for on-site wastewater disposal.

An On-Site Sewerage Management system (OSSM) is designed to:

1. Dispose of treated effluent on-site using an approved and effective methodology in accordance with the Environmental Health Protection Guidelines (DLG 1998) and AS/NZS 1547:2012 (SAI & NZS 2012).
2. Meet the environmental and health *Performance Objectives* documented in the Environmental Health Protection Guidelines (DLG 1998) which ensure that on-site sewage management for single households is appropriate and will not affect public health or the environment.
3. Satisfy the requirements documented in Chapter G8 (Onsite Sewage Management) of Council's DCP (2014).

The objectives are:

- **Prevention of public health risk**. Contact with effluent should be minimised or eliminated, particularly for children. Residuals, such as composted material, should be handled carefully. Treated sewage should not be used on edible crops that are consumed raw
- **Protection of lands** - on-site sewage management systems should not cause deterioration of land and vegetation quality through soil structure degradation, salinisation, waterlogging, chemical contamination or soil erosion
- **Protection of surface waters** - on-site sewage management systems should be selected, sited, designed, constructed, operated and maintained so that surface waters are not contaminated by any flow from treatment systems and land application areas (including effluent, rainfall run-off and contaminated groundwater flow)

2. EXISTING DEVELOPMENT

The Site is a mostly cleared and partly developed parcel of land. A *Google Earth* image over the Site showing existing conditions is presented in **Figure 1**. Fenced paddocks cover the northern 60% of the Site. Three small farm dams are located in the northern part, two of these on the north-eastern fall and the third in the north-western corner. A wind mill is located on the northern edge of Coomonderry Swamp in the southern part of the Site (**see Plate 1**).

3. SITE INFORMATION

The Site is an approximate 74.8 hectare multi-sided but broadly wedge-shaped parcel of rural land oriented north-south. The Site is in the Shoalhaven City Council local government area and borders the southern side of Beach Road approximately 3.8 km east-southeast of its intersection with Agars Lane and 1.3 km west of its intersection with Gerroa Road.

The Site is surrounded by rural/residential properties to the east and west. There is mains power available to the Site but no town water or municipal sewerage system.

4. SITE ASSESSMENT

The Site is located within undulating low coastal hills and coastal wetlands. The Site is separated into two watersheds by a low-lying northwest-southeast trending ridge system that dissects the central northern part of the Site (**Figure 3**). Although no defined drainages occur on the Site, Coomonderry Swamp covers the southern 30 %. Overland flow north of the divide drains to Beach Road and south of the divide to Coomonderry Swamp. The elevation of the Site ranges from close to sea level at Coomonderry Swamp to about 30.0 m in the central part atop the divide.

The average slope of the Site away from the divide is approximately 10 to 15 %.

5. GEOLOGY

The Site is directly underlain by sedimentary rocks which belong to the Lower Permian-age Shoalhaven Group, in particular the Berry Siltstone. Colluvial deposits on the hillsides in the area are the products of erosion from the Berry Siltstone. The Berry Siltstone consists of interbedded, dominantly flat-lying, mid grey to dark grey siltstone and fine sandstone. Strongly weathered outcrop was observed on the more elevated central parts off the Site.

The Berry Siltstone on the flanks of coastal valleys and hillsides in the district is variably deeply weathered and generally covered with a silty sandy colluvial and residual silty sandy loam to sandy-silty clay soil profile which can vary in thickness

from 0.2 m to greater than two metres. The soils are predictably thicker in the lower parts of the valleys and on the flanks of the ridge systems where deep colluvium (and alluvium) can be developed, such as is the case in the northern and southern parts of the Site.

6. SOIL ASSESSMENT

The reader is referred to the soil mapping carried out by The Department of Conservation and Land Management (Hazelton P.A., 1992). The soils beneath the Site are grouped into three soil landscapes:

- The Coolangatta Soil Landscape which is a residual soil landscape developed on undulating rises and low rolling hills. This soil covers the majority of the Site.
- The Shoalhaven Soil Landscape which is an alluvial soil landscape mapped in the far north-western part of the Site.
- The Seven Mile Soil Landscape which is an estuarine soil landscape occupying Coomonderry Swamp in the southern part of the Site.

Soil investigations recently carried out by SEEC in the central part of the Site revealed that this area is directly underlain by residual soils belonging to the Coolangatta Soil Landscape. The soil profile comprises approximately 0.2 to 0.3 m of dark brown strongly pedal loam overlying 0.2 to 0.5 m dark brown moderately pedal sandy clay loam. Strongly weathered shale to fine sandstone was intersected between approximately 0.8 and 1.0 m depth.

Soil investigations in the north-western part of the Site intersected a sequence consisting of interlayered grey weakly pedal clay loam and mottled grey-orange clay loam grading down into light/medium clay. Strongly weathered shale was recorded at about 0.9 m depth in the north-western corner.

Groundwater was not encountered in the SEEC investigations.

7. HYDROGEOLOGY

7.1 Aquifers

The sedimentary rocks belonging to the Shoalhaven group generally possess low porosity and permeability resulting in restricted groundwater flow. Localised water bearing zones (aquifers) may occur. Groundwater hosted by the Shoalhaven Group is generally brackish with very low yields.

7.2 Aquifer Recharge

Aquifer recharge is primarily by way of excess precipitation (rainfall), in particular the water that infiltrates the vadose (unsaturated) zone and is not consumed by evapotranspiration. A proportion of this recharge will provide base flow to the drainages in the district.

7.3 Aquifer Discharge

The reported existence of springs in the more elevated part of the Site indicates the presence of 'shallow' groundwater which is often collectively referred to as 'water features' or 'springs'. Three discharge sites were identified by the owner and inspected in September 2017. The locations of the known springs are shown in **Figure 4**:

1. An area of 'dry' exposed, disturbed soil located on the southern elevated side of the central ridge system at about 22 m RL (**see Plate 2**). The spring is located within a 30 m-wide corridor regularly travelled by dairy cows. There was no evidence of any groundwater seeps at the time of the site inspection.
2. A grassed covered area in a fenced paddock on the northern side of the central ridge south of the dwelling in the north-western part of the Site. The elevation of the spring is approximately 22 m RL (**see Plate 3**). A relatively small covered concrete tank has been historically buried in this location to presumably intercept and detain some of the shallow groundwater discharging at this point.
3. An area of 'dry' exposed disturbed soil located on the northern elevated side of the central ridge system at about 22 m RL (**see Plate 4**). There was no evidence of any groundwater seeps.

Inspection of the 'spring' sites (groundwater discharge zones) in September 2017 did not reveal any surface groundwater discharge or wet areas.

Conceptually, the groundwater system associated with springs is simple. It consists of:

- A **recharge area** where water enters the subsurface
- An **aquifer or set of aquifers** through which the water flows, and
- A **discharge point** where water emerges at the ground surface as a spring

The existence of springs on the elevated part of the Site indicates that some of the recharge infiltrates down to very shallow zones, likely down to the base of the weathered zone where 'perching' of shallow groundwater may occur. This water then migrates laterally down gradient.

The existence of a spring requires that below the ground surface, the infiltrating water encounters a low-permeability zone and is unable to continue to percolate downward as fast as it is supplied at the surface. As a result, the water migrates laterally until it

intersects the land surface potentially discharging as springs where erosion has lowered the topography to the water's level (e.g., on the side of a gully, hill or valley). This is the situation to the north and south of the ridge line in the central part of the Site. For many people, springs are the most obvious and interesting evidence of groundwater.

Although the discharges from these springs are believed to vary in response to seasonal and climatic factors, anecdotal evidence indicates that they are low volume intermittent flows and/or seeps sometimes in an amount large enough to form a pool or stream-like flow. Spring discharge of local subsurface flow systems is closely related to recharge of precipitation and can show wide fluctuations in flow. Anecdotal evidence indicates that the seep on the southern side of the ridge system sometimes renders the ground wet (muddy).

The apparent elevation control of these springs (about 22 m RL) may also be associated with a geological contact within the flat-lying siltstone and sandstone beds, that is, 'contact springs' associated with the permeability contrast between a relatively permeable upper sedimentary bed and less permeable ('tight') contact or lower sedimentary unit.

The importance of spring systems is that they can support *Groundwater Dependant Ecosystems* (GDEs) which can be established at these groundwater discharge points.

7.4 Groundwater Dependent Ecosystems

Groundwater Dependant Ecosystems (GDEs) are ecosystems with potential for reliance on either the surface or sub-surface expression of groundwater. Ecosystems can be classified into three main categories according to their dependence on groundwater:

- Non-dependent;
- Facultative with some degree of groundwater dependence. This category can be subdivided into opportunistic, proportional and highly dependent; and
- Highly dependent/obligate.

Inspection of the 'spring' sites (groundwater discharge zones) in September 2017 did not reveal any surface groundwater discharge or the presence of GDEs. No other groundwater discharges were noted during the site inspection and no other features have been reported on the Site by the owner in his residence over several decades.

8. PROTECTION OF SHALLOW GROUNDWATER FEATURES

Any re-development of the Site (proposed rezoning) must ensure protection of the known shallow groundwater features (springs) from any potential adverse impacts from the on-site application of treated effluent.

In this regard, the Environmental Health Protection Guidelines (DLG 1998) and AS/NZS 1547:2012 (SAI & NZS 2012) provide a set of guideline buffer setback distances from 'site features' including 'bore/well' as defined in Table R1 in AS/NZS 1547:2012 (page 185). Although the water features are relatively small scale with no apparent associated dependent ecosystems, they are nevertheless categorised as shallow groundwater systems. Therefore the setback distances are considered appropriate for their protection.

The Environmental Health Protection Guidelines (DLG 1998) suggest a setback distance of 250 m (domestic water well (bore)). However, it is noted that Table R1 in AS/NZS 1547:2012 provides concessions on buffer distances from a bore/well and groundwater. In this regard, a range of setback distances between 15 and 50 m is recommended for a 'bore/well' and 0.6 to greater than 1.5 m for 'groundwater' based on a variety of sensitivities, limitations and parameters listed in Table R2 of AS/NZS 1547:2012. The items in Table R2 requiring assessment against a scale of constraints are A, C, H & J for a 'bore/well' and A, C, F, H, I, J for 'groundwater'. These are assessed in **Table 1**

Table 1
Assessment of Buffer Constraint Levels

Item	Assessed Constraint Level	Rationale
A	Lower	Any domestic wastewater on new allotments will be treated to minimum secondary standard as recommended and specified by SEEC (2017)
C	Lower	Groundwater pollution hazard: Category 4/5 (clay loam to light clay) soil overlying bedrock.
F	Lower	Drainage Issues: Category 4/5 (clay loam to light clay) soil overlying bedrock on overall gently sloping site.
H	Medium to high close to springs	Groundwater pollution hazard: Category 4/5 (clay loam to light clay) soil with water table predicted to be relatively 'deep' but intermittent spring activity at approximately 22 m RL.
I	High immediately downslope of springs	Groundwater pollution hazard: resurfacing hazard
J	Lower	Off-site export of effluent, surface water pollution

In order to achieve an overall lower potential hazard the nominal buffer setback distance between a known spring on the Site and any proposed application of secondary treated wastewater (effluent management) should be no less than:

- 15 m sideslope
- 30 m upslope
- 50 m downslope

The downslope setback is also nominated to prevent any spring flow migrating downslope and impacting the LAA. The areas surrounding the known springs not considered suitable for application of treated wastewater are annotated in **Figure 4**.

9. CONCLUSIONS AND RECOMMENDATIONS

It is understood that the owner proposes to rezone part of the Site to R5 (Large Lot Residential). An assessment of on-site disposal of treated effluent (wastewater) from any new residential allotments on shallow groundwater systems revealed the presence of three relatively small water features (springs) known on the Site. These springs are shallow groundwater discharge zones associated with a contact between two sedimentary rock units (layers) in the relatively flat-lying, low-permeability Permian Berry Siltstone, part of the Shoalhaven Group.

The springs are located on the north and south sides of a small ridge system in the central part of the Site at an elevation of approximately 22 m RL. Inspection of the 'spring' sites did not reveal any surface groundwater discharge or the presence of any GDEs. No other groundwater discharges were noted during the site inspection and no other features have been reported on the Site by the owner in his residence over several decades.

In order to protect the known springs on the Site from any potential impacts associated with possible on-site disposal of treated effluent, a set of buffer setback distances has been developed based on guideline distances documented in AS/NZS 1547:2012. The downslope setback ensures that any spring flow will not migrate downslope and impacting any Land Application Areas.

10. REFERENCES

DLG. 1998. *Environmental Health Protection Guidelines – On Site Sewage Management for Single Households*.

Hazelton, P.A. 1992. *Soil Landscapes of the Kiama 1;100,000 Sheet* Report. Department of Conservation and Land Mnagement. Sydney.

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For and on behalf of
Larry Cook Consulting

Larry Cook
Hydrogeologist

PLATES

Plate 1 Windmill

Plate 2 Spring – Southern Side of Divide

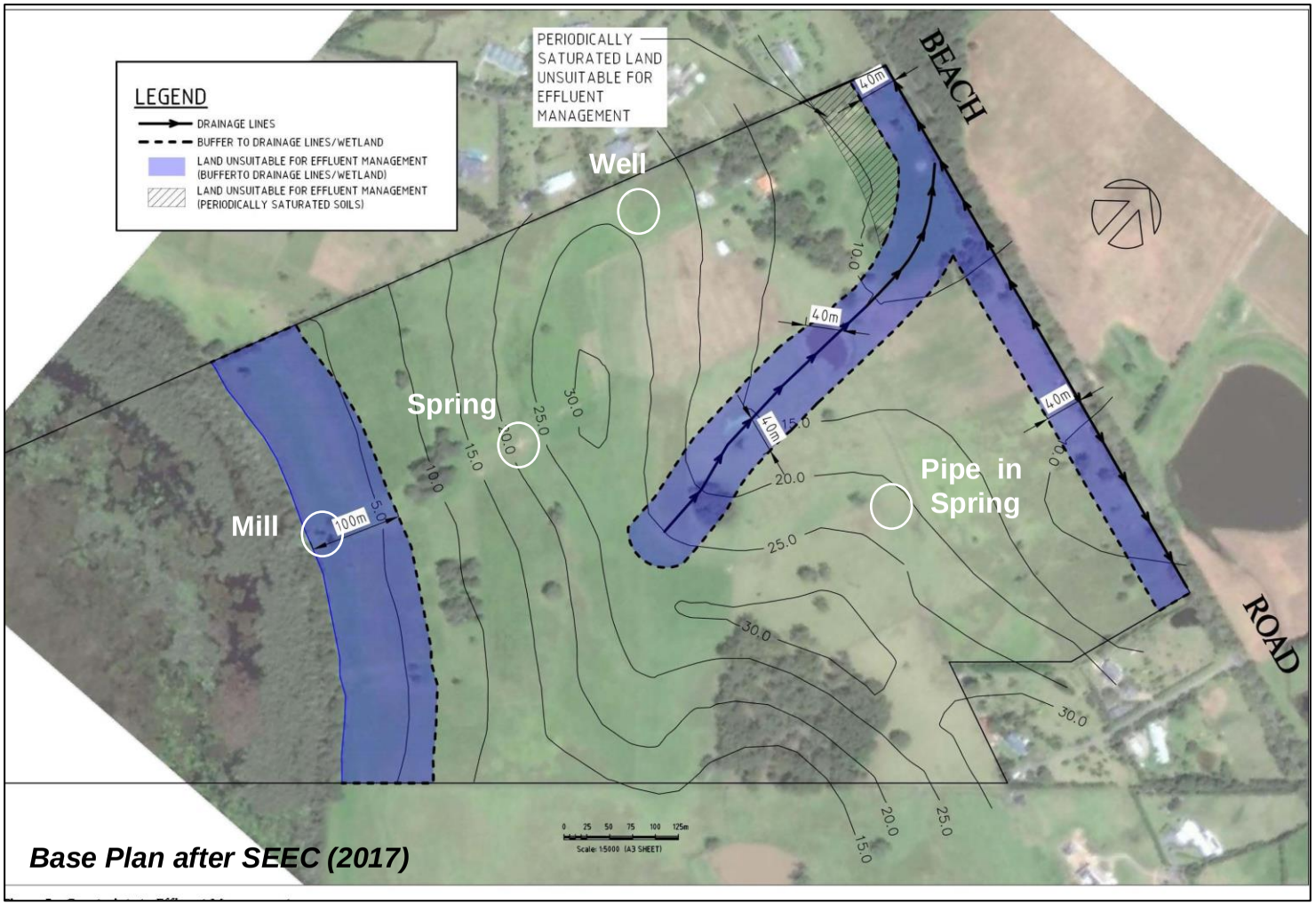
Plate 3 Spring – Northern Side of Divide North-Western Part of Site

Plate 3 Spring – Northern Side of Divide Central Northern Part of Site

FIGURES

Larry Cook Consulting **PO Box 8146** **Tumbi Umbi NSW 2261** **Phone 02 4340 0193**	**Hydrogeological Assessment**	Scale: As shown
	Lot 4 in DP834254 **510 Beach Road Berry** Lot Plan	**FIGURE 1**

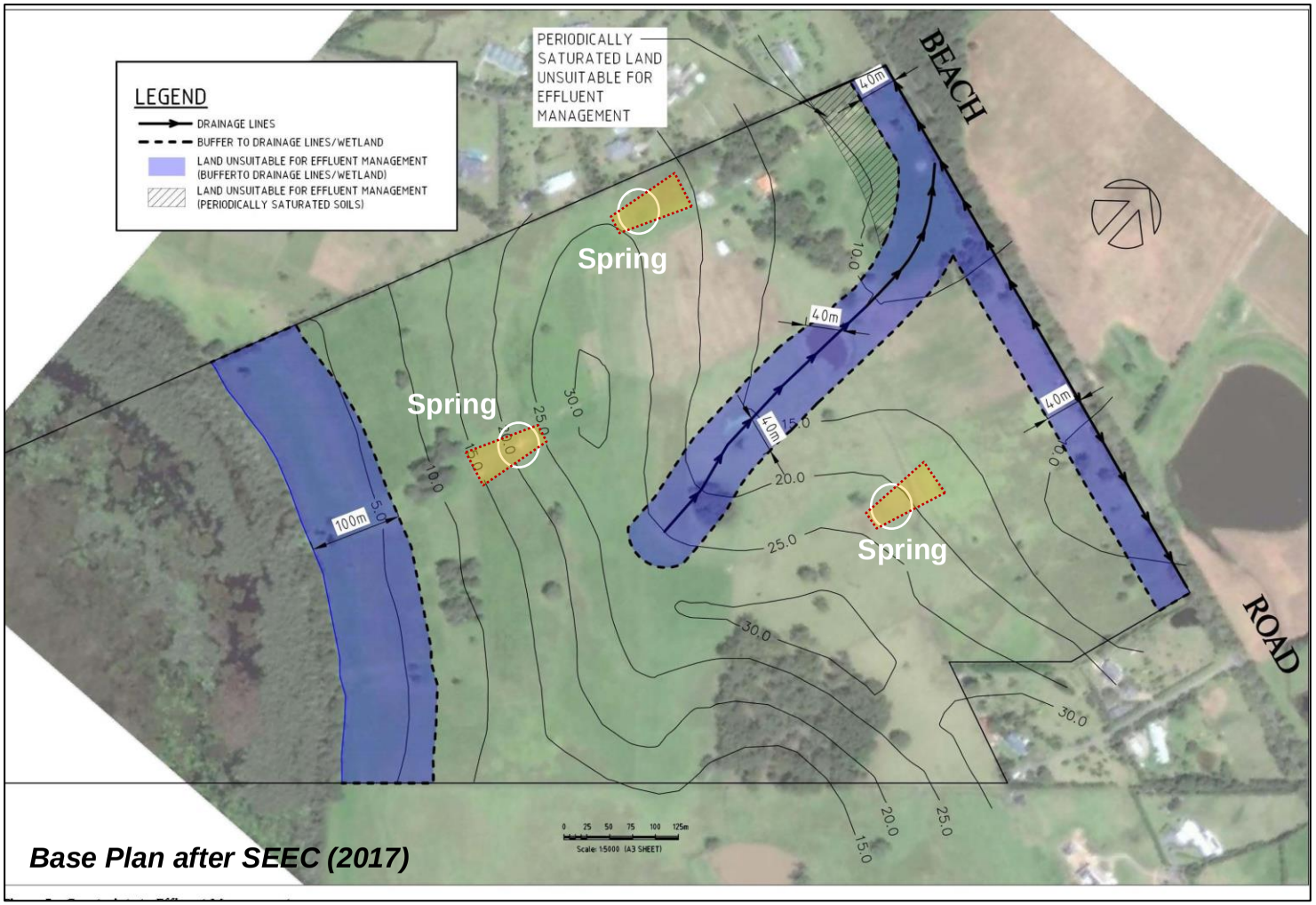
Larry Cook Consulting **PO Box 8146** **Tumbi Umbi NSW 2261** **Phone 02 4340 0193**	**Hydrogeological Assessment** **Lot 4 in DP834254** **510 Beach Road Berry** Topographic Plan	**N**	Scale: As shown **FIGURE 2**



0 m 100

N

Larry Cook Consulting **PO Box 8146** **Tumbi Umbi NSW 2261** **Phone 02 4340 0193**	**Hydrogeological Assessment** **Lot 4 in DP834254** **510 Beach Road Berry** Site Plan	N	Scale: As shown **FIGURE 3**



Land Considered Unsuitable for Effluent Management (known springs)

0 m 100

N

Larry Cook Consulting **PO Box 8146** **Tumbi Umbi NSW 2261** **Phone 02 4340 0193**	**Hydrogeological Assessment** **Lot 4 in DP834254** **510 Beach Road Berry** Areas Unsuitable for Effluent Disposal	N	Scale: As shown **FIGURE 4**