

Site and Soil Evaluation for Onsite  
Wastewater Management

Smiths Beach Project

Lot 4131, Smiths Beach Road,  
Yallingup, WA

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Date: 03 June 2022

Ref: 301247423

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# Revision

Revision	Date	Comment	Prepared By	Approved By
001	30/05/2022	Issued for Review	RB	RB
002	03/06/2022	Issued for Approval	RB	RB

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# 1. Introduction

This report has been prepared to support the recommended onsite wastewater strategy for the proposed development (“Proposal”) for Lot 4131 Smiths Beach Road, Yallingup, WA (“Site”). This report intends to follow the instructions set out in the Department of Health’s *Guidance on Site and Soil Evaluation (SSE) for on-site sewage management*, which utilises the SSE process outlined in AS/NZS 1547:2012.

The report outlines a culmination of significant investigation and reporting for the site from engineering, planning, environmental, geotechnical, and hydrological analyses of the site.

The following parties have prepared this report for the Proposal.

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## 1.1 Report Summary

This report intends to provide a suitability assessment for onsite wastewater management for discussion with relevant Authorities to agree the type and arrangement of onsite wastewater systems for the Proposal.

It is recommended that the Proposal is serviced via onsite wastewater treatment and land application systems and will be undertaken in accordance with the Government Sewerage Policy 2019. The current approved Structure Plan for the site was guided by the Combined Methodologies (CM) which were prepared in 2004 and proposed that the Site was to be serviced by reticulated sewerage. The introduction of the Government Sewerage Policy 2019 replaced the 1995 Policy and two Draft Policies to ensure that where it is not reasonable to connect to reticulated sewerage (i.e. where it is not available) that the design of treatment and land application systems is assessed in accordance with the current best practice directions for on-site wastewater treatment and disposal being AS1547:2012 – On-site Domestic Wastewater Management. This is also in conjunction with the Department of Health undertaking major legislative reform to replace the Health Act 1911.



Due to the unavailability of reticulated sewerage and the Proposals lower site yield and produced sewer effluent, as compared to the potential development that can be achieved under the current Structure Plan, consideration of on-site wastewater treatment and disposal is considered appropriate. The reduced density of the Proposal results in suitable areas to accommodate on-site disposal which couldn't be achieved through the higher density of development as allowable under the current Structure Plan.

The site wastewater loading has been assessed based on the uses throughout the Proposal in a conservative nature based on the level of detail provided at this stage of the development.

- Holiday Homes (part of Community Title)
  - Western Holiday Homes
  - Eastern Holiday Homes
- Campground (separate Green Title Lot)
  - Separate Green Title Lot
- Hotel & Community Hub (part of Community Title)

### 1.1.1 Eastern Holiday Homes

Each lot will provide secondary treatment at minimum with nutrient retention and dispose of effluent within its own lot area in accordance with the minimum requirements defined by the SSE and as approved by the relevant Authority bodies.

Some locations within the eastern precinct have been identified with lower levels of overburden, in these instances suitable methods of additional fill along with other mitigation methods may be required on individual lots.

### 1.1.2 Campground

The campground will treat and dispose of effluent within its own green title lot area in accordance with the minimum requirements defined by the SSE and as approved by the relevant Authority bodies.

### 1.1.3 Western Holiday Homes

Some areas of the western holiday homes are characterised by near surface rock, potentially making disposal on its own lot difficult. These locations are varied over the Western holiday home systems typically consists of normal elements namely:

- Pipe reticulation
- Where able based on lot specific geotechnical investigations, disposal within its own lot in accordance with the minimum requirements defined by the SSE and as approved by the relevant Authority bodies.
- Where unable based on final geotechnical investigations, connection to Pumping Station and Wastewater Treatment System.

### 1.1.4 Hotel & Community Hub

The system consists of normal elements namely:

- Separation of Waste Streams (Trade Waste)
  - Inclusion of appropriate pre-treatment devices prior to connection to the primary sewer stream
- Pipe reticulation
- Pumping Station and Rising Main
- Wastewater Treatment System
  - Secondary Treatment Plant with additional consideration of higher treatment level for re-use
- Disposal of Treated Effluent within Open Space



### 1.1.5 Sewerage Reticulation

Where sewerage reticulation is proposed, namely the Hotel, Community Hub and western holiday homes, the systems consist of normal PVC sewer pipe (150mm), precast access chambers and where applicable lot connection junctions. Due to the topography of the Site, the system would be a gravity installation, falling to a pumping station at the lowest level of the Site. Pipework depths would be minimised as much as possible and likely to be in the order of 1m to 2m in depth throughout.

Note that the Hotel and Community Hub precincts would have a private internal reticulation system in accordance with AS3500.2, which would then connect into the main wastewater treatment plant via a sewer pump station and rising main.

### 1.1.6 Recommendations Summary

To select the most appropriate effluent collection, treatment and disposal system, engineering, hydrological, geotechnical, and environmental studies have been completed which are then assessed against a risk framework. Additional site perched water modelling and geotechnical investigations for winter permeability are in progress with initial results indicating support for the proposed approach. Ongoing monitoring is being conducted for the upcoming winter to validate modelled results.

The outcome of the risk framework process, also identified as a site and soil evaluation, is to recommend the minimum level of treatment required as well as appropriate options for land application systems.

**Table 1: Onsite effluent disposal major considerations**

Characteristic	Recommendation
Low Infiltration Ability	The development site is categorized with a wide range of Soil Categories dependent on location, in this manner, land application area minimum requirements will vary and have been demonstrated throughout this report to meet areas sized for no winter storage.
Separation to Rock/Perched Water	Disposal areas are required to maintain a minimum on 0.6m of vertical setback to impermeable underlying limiting layers and perched water flow pathways.  Current modelled results of these layers have been undertaken to identify at risk locations that may require additional treatment (such as fill) to achieve these setbacks.
Slope	Development slope analysis indicated typically ~10% slope throughout.  Development land application areas are to ensure minimum slopes where possible with engineered solution incorporated into final design to mitigate impact of increased slopes.
Climate	Pan evaporation rates do not exceed rainfall during winter months with land application areas selected for size based on water balance for no storage.
Nutrient Balance	Due to the variance of soil categories throughout the development, a nutrient management plan suited to soil category will be implemented to ensure appropriate application qualities. Nutrient retention of nitrogen and phosphorous is required as a minimum above secondary treatment.
Vegetation	A number of significant flora and vegetation areas are identified throughout the development with the project intent to protect these so that biological diversity and ecological integrity are maintained. Land application systems that minimise clearing and incorporate low impact installation will be assessed in specific design.

To minimise impact to the Site the recommendation for secondary effluent treatment systems with nutrient removal are identified as the minimum level of wastewater treatment throughout the Proposal. All effluent disposal systems will be required to comply with the Department of Health approval and to the satisfaction of the Local Government.

Due to the range of soil categories throughout the Site, land application areas have been based on drip irrigation for disposal with no winter storage to demonstrate the largest impact of land area required to safely discharge treated effluent with the lowest risk of human exposure to wastewater.



## 2. Site and Development Description

The development site, identified as Lot 4131 Smiths Beach Road, Yallingup, is a 40.5ha parcel of land represented by Figure 1 below. This is a freehold lot owned by Smiths 2014 Pty Ltd.



**Figure 1: Current Land Tenure Plan**

The development is to be operated under the Community Title Framework as a subdivision of the freehold green title land parcel into a community scheme as a part of the implementation of the *Community Titles Act 2018* (CT Act).

As it relates to the on-site wastewater treatment and land application systems, the following outlines the operational intent:

- The Community Corporation is responsible for the maintenance and management of individual holiday home treatment and land application systems (Eastern Holiday Homes) and the wastewater treatment plants and land application systems (Selected Western Holiday Homes, Hotel & Community Hub). The City of Busselton and/or the Department of Health will have an agreement directly with the Community Corporation to address any concerns or actions, not individual owners.
- The Community Corporation will arrange necessary monitoring, maintenance, and reporting to Authorities of systems on behalf of the owners in line with any approval conditions.
- The Community Corporation will outsource wastewater treatment plant and sewer scheme operations to a competent third party operator.
- Levies are payable to the Community Corporation for the ongoing monitoring, maintenance and reporting of each system which will be payable by the individual Hotel & Community Hub Owner and Holiday Home owners.



- Holiday Home treatment and land application systems are located on each lot under private ownership. Where effluent discharge cannot occur on lot due to unfavourable conditions the Community Corporation will facilitate irrigation within open space areas.
- Through by-laws, the Community Corporation will have the power to access any lot to carry out routine monitoring, inspection, and maintenance.
- Liability for the failure of any treatment system will be jointly on the Community Corporation and the respective owner with the Community Corporation addressing and rectifying any issues/concerns and seeking reimbursement via the owner.
- The Campground will reside on a separate Green Title Lot and the management of this is able to be incorporated into the management agreements through the Community Corporation.

The following diagram demonstrates the proposed breakup of lots within the Community Title for the development.



Figure 2: Lot Use Breakup [TBB, 15/09/2021]



## 2.1 Wastewater Loading Rates

The site wastewater loading has been assessed based on the uses throughout the development on a conservative basis as it assumes all uses are fully occupied on the same day.

- Holiday Homes
  - Western Holiday Homes
  - Eastern Holiday Homes
- Campground
- Hotel & Community Hub

### 2.1.1 Holiday Homes

**Table 2: Holiday Home Wastewater Loading**

Premises	Number of Bedrooms	Volume of Wastewater (L/day)
Single Holiday Home (Individual allowances)	r.1 – 2 bedrooms or less	564 L/day
	r.2 – 3 bedrooms	761 L/day
	r.3 + r.4 - 4-5 bedrooms	829 L/day
Eastern Holiday Homes	46 off	829 L/day
Western Holiday Homes (r.3/r.4)	15 off	829 L/day
<b>Total Holiday Homes</b>		<b>50,569 L/day</b>

### 2.1.2 Campground

**Table 3: Campground Wastewater Loading**

Premises	Quantities	Equivalent Use	Combined Flow (L/person/day)	Total daily loading (L/day)
Campground	36	2 persons/tent site	140 L/person/day	10,080 L/day
	4	Caravan Park Staff (not living onsite)	70 L/person/day	280 L/day
<b>Total Campground</b>				<b>10,360 L/day</b>



### 2.1.3 Hotel & Community Hub

Table 4 identifies wastewater loading for the Community Hub and Hotel on a conservative basis as it assumes all spaces are fully occupied on the same day. This assessment method provides inherent contingency as there will be a large amount of reciprocal use amongst the Tourist Development. For example, the hotel guests will also use the Restaurant and Bakery.

**Table 4: Hotel & Community Hub Wastewater Loading**

Premises	Quantities	Equivalent Use	Combined Flow (L/person/day)	Total daily loading (L/day)
Hotel Rooms	65	Hotel (2 Guests/room)	180 L/person/day	23,400 L/day
	33	Hotel Staff	70 L/person/day	2,310 L/day
Wellness Centre (Spa & Gym)	8	Health Centre (Showering)	70 L/person/day	560 L/day
	-	Spa Staff	Inc. in Hotel Staff	-
Recreation Lounge and Bar	50	Flexible working space – membership based	30 L/person/day	1,500 L/day
Arrival Pavilion	-	Hotel Guest Users	Inc. in Hotel Guests	-
Restaurant	200	No of Seats (per sitting – 3 per day)	30 L/sitting/day	18,000 L/day
	-	Restaurant Staff	Inc. in Hotel Staff	-
Cape to Cape Welcome Centre	20	Users (Casual)	10 L/person/day	200 L/day
	5	Staff (Office)	30 L/person/day	150 L/day
Café	174	Café sit in Customers (per sitting – 2 sittings per day)	30 L/sitting/day	10,440 L/day
General Store/Bakery & Hire Shop	25	Bakery Sit in Customers (per sitting – 2 sittings per day)	30 L/sitting/day	1,500 L/day
	9	Café, General Store, Bakery, Hire Shop Staff	70 L/person/day	630 L/day
Surf Life Saving Club	50	Clubs (Licensed), Showering	70 L/person/day	3,500 L/day
	5	SLS Staff	70 L/person/day	350 L/day
Reception Hall	150	Number of Seats (per sitting – 3 per day)	30 L/person/day	4,500 L/day
	15	Reception Hall Staff	70 L/person/day	1,050 L/day
Public Toilets	50	Gym (With Showers)	70 L/person/day	3,500 L/day
<b>Tourist Development &amp; Community Hub Total</b>				<b>71,590 L/day</b>

We note that trade waste generating elements within the Hotel and Community Hub development will require the installation of suitably sized pre-treatment devices prior to connection to the wastewater treatment systems. The Water Corporation of Western Australia trade waste guidelines will be used as a best practice implementation of pre-treatment devices and processes to ensure that particularly fats, oils and grease are not transported in the sanitary plumbing network.



### 3. Site and Soil Assessment

The following Masterplan, Figure 3, includes the Site location of relevant buildings, roads and pathways generally.

The Site is not constrained within any sewage sensitive areas and the most northern boundary with the ocean interfaces with the Hotel and Community Hub development. There is no intent to treat or dispose of wastewater within this portion of the development achieving a minimum 100m buffer from the coast.



Figure 3: Masterplan



### 3.1 Site Assessment Summary

The following table outlined the level of constraint identified for the development and the design mitigation measures considered to address these.

Additional monitoring has been completed, however, this report will be revised to ensure that any altered levels of constraint and relevant mitigation measures are incorporated into the design.

**Table 5: Key Site Characteristics Assessment**

Site Characteristics	Investigations & Reporting Summary	Level of Constraint	Design Mitigation Measures
Climate	Excess of rainfall over evaporation in the wettest months of the year.	High	Water balance to be undertaken for individual soil categories and demonstrate ability to have suitable land application areas without storage.
Exposure	North facing site, high exposure to sun with low shading allowing maximization of evapotranspiration of effluent.	Low	Final land application methods to consider shallow sub-soil methods where possible.
Vegetation	Refer to Section 3.3 Vegetation for further details.  The environmental objective is to protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Moderate	Unless approved by the project environmental management plan or other, clearing for land application areas will be limited. Low impact installation systems are recommended.
Slope	The majority of the development ranges between 4-10% slope as presented in the Slope Study.	Low	Additional design mitigation methods may be introduced in areas where retaining or other structures are formed.
Fill (imported)	No fill has been encountered to date within the development site.	Nil	Additional good quality imported fill may be utilised locally for site leveling or to the benefit of the proposed land application system(s).
Surface Gravel and Rock Outcrops	Rock outcrops have been identified within the current Geotechnical Investigation report (refer Appendices).	Moderate	Land application areas are designed to avoid areas of rock outcrops and are either to be disposed of on each eastern/western holiday home lot or over the private open space areas.
Erosion Potential	Potential of erosion has been noted within the current Geotechnical Investigation report (refer Appendices).	Moderate	Land application areas are designed to avoid areas of rock outcrops (areas or erosion potential) with appropriate retention and cut off drains in areas of fill or build up.



Site Characteristics	Investigations & Reporting Summary	Level of Constraint	Design Mitigation Measures
Separation from groundwater	No groundwater has been experienced at the development, however further perched water modelling and investigations are ongoing. Current results as outlined within the latest geotechnical advice indicated no groundwater experienced. Any additional readings will be provided and updated accordingly.	Nil	N/A
Public Drinking Water Source Areas (PDWSAs) and Sewage Sensitive Areas (SSA)	None identified.	Nil	Separation to coastline is achieved through the implementation of the Hotel and Community Hub precinct with no treatment or land application occurring within 100m of the coastline.
Surface waters and separation from water resources	Perched water and 'soak' investigations ongoing. Current results as outlined within the latest geotechnical advice indicated no groundwater experienced. Any additional readings will be provided and updated accordingly.	Moderate	Further investigations and modelling are being undertaken to determine any perched water flows and their impacts.
Rainfall run-off and seepage	Stormwater diversion and management systems are to be implemented within the development to divert stormwater runoff away from land application areas.	Low	Stormwater drainage design implementation to divert stormwater away from land application areas.  Land application areas are being selected in high permeable soils.
Flood potential	No seasonal inundation is currently expected in land application areas.	Nil	N/A
Horizontal Setback Distances	Horizontal setback distances have been allocated as noted in Appendix H, these distances shall be maintained as a minimum throughout the development.	Low	Agreed distances shall be met for the design documentation.
Available Land Application Area (LAA)	The total land application areas currently exceed requirements for winter storage as demonstrated in the water balance sheets presented.  Moderate rating retained until final areas and systems are agreed.	Moderate	Final layouts to be confirmed for each land parcel.

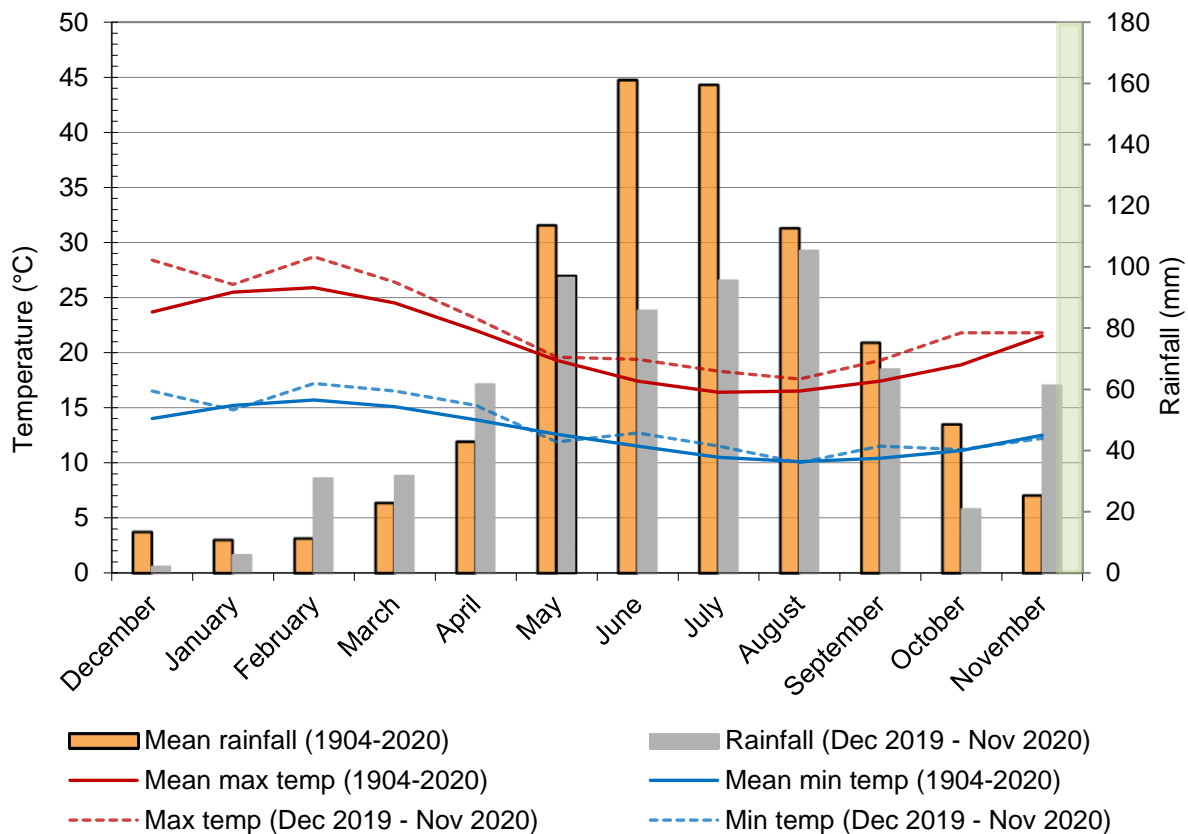


## 3.2 Climate & Exposure

The below summary has been extracted from the *Strategen JBS&G, Environmental Assessment Report* in relation to site climate.

The Naturaliste-Leeuwin coastline experiences a Mediterranean climate with warm to hot, dry summers and mild, wet winters. High-pressure cells dominate climatic patterns during summer and the passage of cold fronts and associated low-pressure cells dominate during winter. Strong sea breezes dominate during late November to early March with much of the site being exposed to strong winds during winter storms.

The mean maximum temperature generally occurs in February and varies between 23°C at Cape Leeuwin and 25.6°C at Cape Naturaliste. Rainfall averages are 833 mm at Cape Naturaliste and 994 mm at Cape Leeuwin. Approximately 60% of the annual rainfall is received between May and August (Bureau of Meteorology 2020).



**Figure 4: Long term and current climatic data for Cape Naturaliste (station #9519)**

(Source Bureau of Meteorology (BoM) 2020)

Climatic averages (rainfall, pan evaporation and wind) for the site have been taken from the nearest meteorological station at *Cape Naturaliste*.

- Site Name Cape Naturaliste
- Site Number 009519
- Latitude 33.54 °S
- Longitude 115.02 °E
- Elevation 109m
- Commenced 1903
- Latest Data Available 30 June 2021



The Site is located on a north facing slope with consistent mean wind exposure between 24.8-32.8km/hr.

**Table 6: BOM Climate Averages**

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
<b>Temperature</b>														
Mean max temp. (°C)	25.5	25.9	24.6	22.0	19.3	17.4	16.4	16.5	17.4	18.9	21.5	23.7	20.8	117 1904-2021
Mean min temp. (°C)	15.2	15.7	15.1	13.9	12.6	11.5	10.5	10.1	10.4	11.1	12.5	14.0	12.7	117 1904-2021
<b>Rainfall</b>														
Mean rainfall (mm)	10.8	11.9	23.1	43.4	113.7	160.5	159.2	112.6	75.3	48.7	25.7	13.4	797.1	116 1903-2021
Mean rainfall (mm)	11.1	7.5	23.8	33.8	101.6	127.7	142.0	113.2	75.3	35.3	26.3	12.2	708.9	29 1991-2020
<b>9 am conditions</b>														
Mean 9am relative humidity (%)	62	65	68	73	77	79	79	78	75	71	67	63	72	51 1957-2010
Mean 9am wind speed (km/h)	27.2	28.2	26.6	25.0	27.3	31.4	31.3	28.3	27.3	26.2	27.1	25.4	27.6	53 1957-2010
<b>3 pm conditions</b>														
Mean 3pm relative humidity (%)	57	56	58	62	69	72	72	70	68	65	61	59	64	71 1937-2010
Mean 3pm wind speed (km/h)	32.8	30.5	27.0	24.8	27.0	31.8	31.9	29.6	28.6	28.9	30.7	32.4	29.7	53 1957-2010

Local Evaporation data has been estimated using the *Evaporation Data for Western Australia* published by the Department of Agriculture and Food (2003). These have been taken from the *Table 1. Monthly and annual Class A pan evaporation rates for various centres in the agricultural areas/ in mm.*

**Table 7: Monthly and Annual Class A Pan Evaporation Rates**

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Margaret River	159	157	69	57	53	47	49	49	53	77	129	171	1070

The following assessment identifies that pan evaporation annually exceeds rainfall, however in the wettest months (May-October) the monthly rainfall exceeds evaporation rates.



**Table 8: Evaporation Rainfall Exceedance Assessment**

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pan Evaporation	159	157	69	57	53	47	49	49	53	77	129	171	1070
Mean Rainfall	11.1	7.5	23.8	33.8	101.6	127.7	142.0	113.2	75.3	35.3	26.3	12.2	709.8
Evaporation Exceed Rainfall?	Yes	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes

Land application areas have been assessed utilising a water balance and the above data.

### 3.3 Vegetation

The below summary has been extracted from the *Strategen JBS&G, Environmental Assessment Report* in relation to site climate for contextual information only. Full details can be found in the complete report.

#### 3.3.1 Vegetation and flora

Emerge (2019) undertook a detailed flora and vegetation survey of the project area in August 2018. More recently Strategen-JBS&G undertook a survey of the adjacent foreshore reserve. Results of these recent surveys are presented in the following subsections.

#### 3.3.2 Regional vegetation

The Site falls within the Southern Jarrah Forest IBRA subregion (JF2) (Hearn et al., 2002; Beard 1990). The vegetation of this subregion comprises jarrah-marri forest in the west grading to marri and wandoo woodlands in the east (McKenzie et al., 2002). The southeast portion of the Site contains swamp vegetation dominated by paperbarks and swamp yate (Hearn et al., 2002).

#### 3.3.3 Pre-European vegetation

Beard et al. (2013) mapping of pre-European vegetation shows the following vegetation associations within the project area:

- 'Chapman 37' over the majority of the Site, which is described as 'shrublands, tea tree thicket' (Beard et al. 2013)
- 'Chapman 990' in very small areas in the eastern and western portions of the Site, which is described as 'low forest: peppermint (*Agonis flexuosa*)' (Beard et al. 2013)
- 'Chapman 1180' in the south eastern and north western portions of the Site, which is described as 'shrublands, *Calothamnus quadrifidus* and *Hakea trifurcata*' (Beard et al. 2013).

'Chapman 37' has 50.38% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 17.77% protected for conservation purposes (Government of Western Australia 2018). 'Chapman 990' has 77.14% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 23.11% protected for conservation purposes (Government of Western Australia 2018). 'Chapman 1180' has 94.03% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 76.28% protected for conservation purposes (Government of Western Australia 2018). The percentage remaining of the three regional vegetation associations mapped in the site exceeds 30%. However, less than 30% of the pre-European Chapman 37 and Chapman 990 vegetation associations are protected for conservation.

#### 3.3.4 Vegetation types

Based on work completed by Emerge (2019) and extended by Strategen-JBS&G (2021), 13 vegetation types were recorded across the Site. A description and the area of each plant community within the Site is provided in Table 9.



Table 9: Vegetation types within the project area

Vegetation types	Description	Area (ha)
AfPe	Low open forest <i>Agonis flexuosa</i> over fernland <i>Pteridium esculentum</i> subsp. <i>esculentum</i> over open herbland mixed non-native species such as * <i>Lysimachia arvensis</i> and * <i>Asparagus asparagoides</i>	8.06
AhHe	Shrubland <i>Allocasuarina humilis</i> over low sparse herbland over low sparse grassland <i>Austrostipa mollis</i> and <i>Rytidosperma occidentale</i> over low open rushland <i>Hypolaena exsulca</i>	1.23
AsDc	Shrubland <i>Acacia saligna</i> and <i>Dodonaea ceratocarpa</i> over low herbland <i>Trachymene Pilosa</i> over low sparse grassland <i>Rytidosperma occidentale</i>	3.31
AsHh	Shrubland <i>Acacia saligna</i> over low open shrubland <i>Hibbertia hypericoides</i> over grassland non-native species such as <i>Vulpia bromoides</i>	0.60
BaMrXp	Low open forest <i>Banksia attenuata</i> and occasional <i>Agonis flexuosa</i> over open shrubland <i>Macrozamia riedlei</i> and <i>Xanthorrhoea preissii</i> over open mixed herbland	4.13
CcHh	Low forest <i>Corymbia calophylla</i> over open shrubland <i>Xanthorrhoea preissii</i> and over low shrubland <i>Hibbertia hypericoides</i> over sparse low herbland <i>Scaevola calliptera</i>	0.67
DciDcL	Shrubland <i>Darwinia citriodora</i> and <i>Dodonaea ceratocarpa</i> over low sedgeland <i>Lepidosperma</i> spp. over low open grassland of native and non-native species over low open herbland <i>Crassula</i> spp.	0.85
KcSg	Closed shrubland <i>Kunzea ciliata</i> and <i>Spyridium globulosum</i> over low open shrubland <i>Eutaxia myrtifolia</i> over sparse sedgeland over low sparse herbland	8.37
KcDcPp	Low open shrubland <i>Kunzea ciliata</i> and <i>Darwinia citriodora</i> over low sparse herbland <i>Stypandra glauca</i> over low sparse grassland <i>Poa poiformis</i> on granite	0.23
MhGI	Low woodland to low open forest <i>Melaleuca huegelii</i> , <i>M. lanceolata</i> and <i>Guichenotia ledifolia</i> over tall open shrubland <i>Hakea oleifolia</i> over shrubland <i>Hibbertia cuneiformis</i> over low open herbland <i>Stylidium adnatum</i>	3.80
MIDr	Low closed forest <i>Melaleuca lanceolata</i> over sparse shrubland <i>Melaleuca systema</i> and <i>Spyridium globulosum</i> over low open herbland <i>Dianella revoluta</i> var. <i>revoluta</i> over low open sedgeland <i>Lepidosperma</i> spp. (understorey absent in areas of dense canopy cover)	1.57
MIKc	Closed shrubland <i>Melaleuca lanceolata</i> and <i>Kunzea ciliata</i> over occasional grasses and herbs	3.41
NfCcXp	Low open forest <i>Nuytsia floribunda</i> and <i>Corymbia calophylla</i> over open shrubland <i>Xanthorrhoea preissii</i> over low open mixed herbland over low open grassland native and non-native species	0.63
Non-native vegetation	Heavily disturbed areas comprising tracks and non-native vegetation with occasional native plants	3.6



### 3.3.5 Potential Impacts

The following is a breakdown of the expected native vegetation clearing and modification requirements.

- 8.17 ha of the site (7.32 ha excluding already cleared areas) to be fully cleared for the purposes of buildings, roads and infrastructure, 2.8ha of this area will be revegetated.
- 12.52 ha of the site (11.14 ha excluding already cleared areas) to be partially modified/managed to cater for modified vegetation and bushfire management. It is expected that >60% of the existing canopy cover will be retained.

The Proposal will directly impact 0.24 ha (2.87%) of the 'Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' PEC situated in the western portion of the Site. Of this, 0.08 ha will be fully cleared, and 0.16 ha will be partially modified. This impact will be confined to the extreme north-eastern extent of the PEC, which is currently fragmented and represents a small proportion of the PEC. This impact will not cause further fragmentation, increase the potential for edge effects or reduce the viability of the PEC extent. Given this, the Proposal is not considered to significantly impact this PEC occurrence.

The Proposal will result in the clearing of vegetation representative of the Wilyabrup complex (We), described as Low woodland and woodland of *Corymbia calophylla*-*Eucalyptus marginata* subsp. *marginata* with some *Banksia* spp. on exposed slopes in hyperhumid to humid zones. This vegetation complex occurs along the Leeuwin-Naturaliste coasts over a large range approximately 94 km north to south. The clearing will reduce the known extent of the Wilyabrup complex by 7%, however, more broadly the complex will have 66% of its total pre-European extent remaining across its range.

The Proposal will result in the clearing of vegetation representative of the Chapman 37 Vegetation System Association (VSA), Chapman 990 VSA and the Chapman 1180 VSA. The Chapman 37 and 990 VSAs are described as an open forest or shrubland of *Melaleuca* and/or *Agonis*. These vegetation associations occur within the southwest corner of Western Australia. The clearing will reduce the known extent of the Chapman 37 VSA by 2%, with 48% of its pre-European extent remaining, while the known extent of Chapman 990 VSA will be impacted by less than 0.3 ha, with 71% of its pre-European extent remaining. The Chapman 1180 VSA is described as a *Calothamnus* mixed open shrubland, representative of the shrubland vegetation in the west of the site. The clearing will reduce the known extent of the Chapman 1180 VSA by 0.2%, however more broadly the complex will have 87% of its pre-European extent remaining across its range.

As identified in Figure 4.2 there are circumstances where a number of *Banksia sessilis* var. *cordata* (P4) individuals (up to 176) may be potentially impacted by the proposed clearing and vegetation modification extent. Site specific detailed design will aim to retain as many individuals as possible. This species is known from 30 additional populations located along the southwest and southern coast of Western Australia (DBCA 2007). Populations are located from Busselton in the north to Denmark in the south. While some impact is likely unavoidable, given the remaining locations are located in the proposed National Park extension, the large known range of the species, the number of extant populations within this range and the representation protected throughout surrounding conservation areas, the proposed impact is not expected to be significant.

### 3.3.6 Mitigation and management

Approximately 19.85 ha of the Site (18.43 ha excluding already cleared areas) will be avoided by the Proposal and is to be fully retained, revegetated (where required) and protected in conservation areas. This represents a substantial proportion of the total Site area (49%). Importantly, this area includes the most intact vegetation in "Excellent" condition.

Of the 7.32 ha of native vegetation proposed to be cleared, 2.8 ha will be subject to revegetation, compliant to the prescribed vegetation densities detailed within the BMP. In addition, a further 1.28 ha of currently cleared areas, outside of the proposed clearing footprint, will be subject to revegetation. These areas are largely represented by existing informal tracks and fire access tracks.

The 12.52 ha subject to modification to allow for the reduction of fuel as part of bushfire risk minimisation will retain canopy cover (trees greater than 4 m in height) at varying densities but will have shrubs and understorey cover reduced as per the specification detailed within the BMP. It is anticipated that >60% of the existing canopy cover in these areas will be retained via this approach. These areas mostly occur within the Strategic Asset Protection Zone (APZ), as well as the proposed holiday home, campground and hotel areas. This treatment is also required within areas of POS, creating a parkland cleared environment in which the retention of tree cover is maximised. This retention of canopy across the Site minimises the impact of the Proposal upon the ecological linkage currently present.



Establishment of all low threat vegetation will be by the Proponent, with ongoing management the responsibility of the Community Corporation which will audit onsite landscaping prior to bushfire season, and conduct spots checks throughout the season. The Community Corporation will implement the BMP and BEMP for the entire precinct. Visitors and holiday homeowners will be required to comply with the management requirements and conditions of the BMP which will be enshrined within the Community bylaws.

All residual impacts to flora and vegetation within the Site will be managed through the implementation of a Construction Environmental Management Plan and development of an offset strategy to be incorporated as part of standard environmental referral to the EPA (under the EP Act) and DAWE (under the EPBC Act).

### 3.4 Topography & Slope Analysis

The below summary has been extracted from the *Strategen JBS&G, Environmental Assessment Report* in relation to site climate.

The Site exists on the Leeuwin-Naturaliste Ridge, which is a unique geological feature approximately 93 km in length between Cape Naturaliste in the north and Cape Leeuwin in the south. As depicted in Figure 3.3, the Site has two major landform components: a gently sloping eastern section that rises to the south away from the beach; and a ridgeline in the western sector that extends seaward in a north westerly direction. The ridgeline forms a slightly raised headland with elevation up to 58 m AHD.

The highest point of the Site is located midway along the southern boundary of the Site having an elevation of 60 m AHD. The eastern half of the Site slopes downwards to the north towards the beach to a level of 4 m AHD. The general slope is moderate, descending approximately one metre in every seven. At the base of this slope is a low-lying area.

A slope analysis of the site was undertaken by MNG and is presented in the figure below.

The majority of the development ranges between 4-10% slope requiring no reduction in design infiltration rates for the development. It is also expected that holiday home lots will undertake some site leveling and this analysis shall be repeated to reflect the post development slope study to ensure that appropriate setbacks are maintained to any retaining structures or adjustments to slope as required.

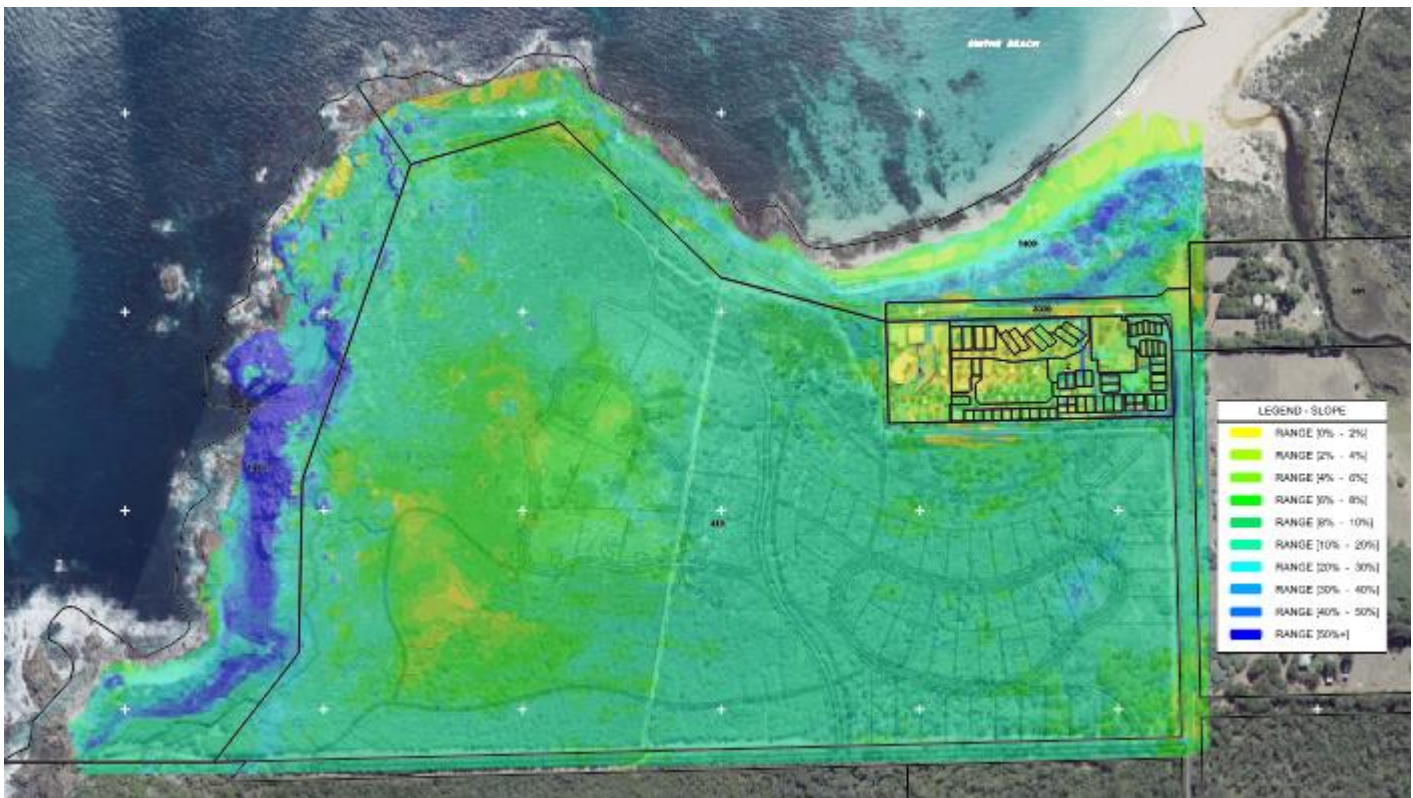


Figure 5: MNG Slope Analysis



## 3.5 Site Stormwater Management

The stormwater strategy for the development will be consistent with WAPC's Better Urban Water Management. The strategy will also be consistent with the intent of the Combined Methodologies for Sussex Location 413 dated February 2014. A Stormwater Concept Plan is included in Appendix C. The underlying principles for various rainfall intensities as outlined in the Engineering Report submitted as a part of the project DA are as follows:

### 3.5.1 First Flush

- To minimise environmental impact, infiltration of stormwater close to source is preferred. It is accepted that 99% of potential pollutants are contained within rainfall events smaller than 1 in 1 year occurrence events.
- Retention or management of the "first flush" rainfall event (nominally first 15mm of a rainfall event) generated from impervious surfaces within residential lots. This will typically be undertaken via soakwells located within sites containing free draining sands. In areas where soakwells are not appropriate, runoff will be diffused and conveyed to the road network where available or incorporated within rainwater tanks where provided.
- "First flush" rainfall from trafficable pavements will be treated within bioretention swales located in areas of free draining soils. Roadside swales will be typically located on the low side of pavements with relatively flat gradients where retention volumes can be more effectively provided. The roadside swales will have intermittent rock pitched weir structures to retain stormwater. Where roadside swales are not appropriate or provided, stormwater will be conveyed to bioretention swales that will typically be located parallel to contours.

### 3.5.2 Minor Storm Event

- Trafficable pavements will typically be designed to cater for a 20% Annual Exceedance Probability (AEP) or 1 in 5 year Average Recurrence Interval (ARI) minor storm event. Conveyance will be either via traditional pit and pipe networks for sections of kerbed pavements or via roadside swales. For roadside swales with underlying free draining soils providing bioretention treatment, the conveyance will be over weir structures. For roadside swales not supporting infiltration, conveyance will be within the swale and dissipated via permeable rock pitching spaced to suit the gradient of the roadway.
- Retention of the 20% AEP event will be typically within sub-surface infiltration structures.

### 3.5.3 Major Storm Event

- Extreme events will be controlled or directed to protect public and private assets.
- The stormwater generated from the 1% AEP event within lots will be typically conveyed via overland flow following the existing landform. The overland flow will typically be directed to roadways or will be directed away from sensitive structures.
- The 1% AEP stormwater within roadways will be flood routed within roadways and designated swale drains to flood attenuation areas.
- Retention of 1% AEP stormwater will be via additional capacity with the sub-surface infiltration structures or temporary flooding to an acceptable level of appropriate land uses (the car park to the south of existing Canal Rocks Apartments).
- Events larger than 1% AEP will discharge overland via the Smiths Lane carpark and Smiths Common (west of Canal Rocks Apartments) to the foreshore. The pollutant load of any stormwater leaving the site would be minimal as the annual first flush event usually carries the highest pollutant loads. The volume of flow exiting the Site is less than that which would currently discharge to the ocean from the existing undeveloped site.

The water sensitive design practices will be tailored to suit the characteristics of the site that include the gradients, irregularity of geotechnical conditions, retention of remnant vegetation, spatial restrictions and safety. Consistent with the principles outlined above, specific treatments for the different situations encountered are summarised as follows:



### 3.5.4 Eastern Cell

- The entry roads and curved sections of pavements are relatively steep. To minimise clearing extents, improve safety around bends and to avoid steep swale drains susceptible to erosion, these sections will be kerbed and drained via a pit and pipe system.
- The east-west sections of road are relatively flat and swale drains retaining the first flush will be adopted. The swale drains will convey stormwater into the piped network for 20% AEP events.
- The piped network will also convey 20% AEP events through the camping site to subsurface infiltration structures within the Smiths Lane carpark.
- Major storm events will be overland flood routed through the roadways to low points to the north-west and north-east of the cell. From both low points, swale drains will provide overland flood routing to the flood storage within the Smiths Lane carpark.

### 3.5.5 Western Cell

- The area is characterised by near surface rock. Pavements will be drained via roadside swales. A section of the southernmost road has underlying sands and suitable to retain the first flush. Other roadside swales will only convey stormwater.
- The section of the southern road falling and connecting midway along the north-south road will have 20% AEP events accommodated within sub-surface infiltration structures.
- Excluding a portion of the southern road referred above, pavements are flood routed to the northern car park and will be piped under the north-south entry road.

### 3.5.6 North-South Entry Road

- Kerb breakouts will be regularly incorporated to direct stormwater to bioretention swales within the abutting open space areas.
- To promote at source infiltration and to avoid a piped network, stormwater generated from the 20% AEP event will be retained within sub-surface structures beneath the bioretention swales.
- 1% AEP events will overland flood route to the northern car park.

### 3.5.7 Smiths Lane Carpark

- The Smiths Lane carpark and access road will be drained via a pit and pipe network. First flush events will be directed off-line to a bioretention swale.
- Sub-surface infiltration structures will be installed beneath the pavement. The catchment of the structures includes the Smiths Lane carpark, north-south entry road, western cell and eastern cell. The structures will be sized for the 20% AEP and 1% AEP less any flood storage provided above ground.
- A contingency overland flood relief will be provided via Smiths Common (west of Canal Rocks Apartments) to the foreshore reserve.

### 3.5.8 Hotel and Community Hub

- The Community Hub is proposed to retain its stormwater on-site via sub-surface structures.
- The hotel complex is located in areas typically containing shallow rock limiting the ability of on-site infiltration. Stormwater will be diffused to maintain pre-development flows to the foreshore reserve.

### 3.5.9 Southern Road

- The new southern road will be drained via roadside swales that will retain the first flush event.
- For the eastern catchment, the 1% AEP event will be flood routed and retained at the low point approximately 140m west of Smiths Beach Road via sub-surface infiltration structures and storage within the swale. The southern verge low point will also retain overland flow from the catchment to the south.



An Urban Water Management Plan has been prepared by Hyd2o (refer DA Appendix P) that should be referred to for further details.

## 3.6 Soil Assessment Summary

### 3.6.1 Current Geotechnical Reporting

According to the Geological Survey of WA's 1:50 000 Environmental Geology Map Series, the site is characterised as Sand (S7) pale and olive-yellow medium to coarse-grained sub-angular quartz moderately sorted in the east, and medium-grained mesocratic Gneiss (GN) in the west. A copy of the mapping is included as Appendix D.

A geotechnical investigation for the site was undertaken by Golder Associates in December 2020 and March 2021 and their subsequent reporting (Golder Associates, December 2021) also considered geotechnical testing historically completed by others. The Geotechnical reporting delineated the site into seven areas that have been replicated within Appendix E. An extract of the report describing the seven areas, as well as the preliminary site classifications determined by Golder Associates, is as follows.

As additional detailed geotechnical and soil investigations are undertaken, soil categories will be outlined in accordance with the requirements of AS1547:2012 and relevant codes/standards.

#### Area 1 - Shallow Rock (Class S)

- Silty SAND (SM), fine to medium grained, generally about 15% low plasticity fines, generally loose becoming medium dense to dense with depth, brown becoming pale brown orange and pale brown grey, extending to depths of between about 0 m (rock outcrops) and 1.9 m, overlying
- Inferred GNEISS/GRANITE cobbles, boulders or bedrock, causing refusal at depths between 0.2 m and 1.9 m.

#### Area 2 - Shallow Clay (Class M)

- Silty SAND (SM) or Sandy GRAVEL (GP), fine to medium grained sand, fine to coarse lateritised gneiss gravel, generally about 15% low plasticity fines, medium dense to dense with depth, brown, extending to depths of between about 0.4 m and 0.5 m, overlying
- Sandy CLAY(CI/CH), medium to high plasticity, very stiff to hard, brown, orange and red, extending to the maximum depth investigated of 1.0 m.

#### Area 3 - Sand (Class A)

- SAND (SP), fine to medium grained, with silt in parts, loose becoming medium dense to dense with depth, orange brown to red brown, extending to the maximum depth investigated of 3.0 m.

#### Area 4 - Sand over Clayey Sand (Class S)

- SAND (SP), fine to medium grained, with silt, loose becoming medium dense to dense with depth, orange brown to grey brown, extending to depths of between about 1.5 m and 2.1 m, overlying
- Clayey SAND (SC), fine to coarse grained, about 15% to 25% low plasticity fines, dense to very dense, orange brown, orange yellow and yellow grey, containing a sand layer between 2.5 m and 3.0 m at HA31, extending to the maximum depth investigated of 3.0 m.

#### Area 5 - Silty Sand (Class S)

- Silty SAND (SP), fine to medium grained, about 10% to 20% low plasticity fines, loose becoming medium dense to dense with depth, red brown to brown, extending to the maximum depth investigated of 2.0 m.

#### Area 6- Silty Sand over Clay (Class M)

- SAND/Silty SAND (SP/SM), fine to medium grained, about 10% to 15% low plasticity fines, loose becoming medium dense to dense with depth, brown, extending to depths of between about 0.8 m and 1.4 m, overlying
- Clayey SAND/Sandy CLAY(SC/CI/CH), medium to high plasticity, very stiff to hard, brown, orange brown and grey, extremely weathered rock, extending to the maximum depth investigated of 2.6 m.



### Area 7 - Shallow Rock (Class S)

- SAND/Silty SAND/Silty Gravelly SAND (SM), fine to medium grained, generally about 15% to 20% low plasticity fines, generally loose becoming medium dense to dense with depth, brown and red brown, fine to coarse gneiss gravel and cobbles, extending to depths of between about 0 m (rock outcrops) and 1.1 m, overlying
- Inferred GNEISS/GRANITE cobbles, boulders or bedrock, causing refusal at depths between 0.3 m and 1.3 m

## 3.7 Site Assessment Results

Based on investigation completed to date along with additional modelling and investigations being undertaken, the project team is supportive of treated effluent being contained within the Site for the proposed uses. In this manner, onsite wastewater management should be considered as feasible for the Site incorporating appropriate design mitigation methods to ensure that land application areas are managed where possible without winter storage.

The results and interpretation of the desktop and field investigations are used to determine whether effluent can be contained within the property boundaries and if onsite wastewater management is feasible.

To select the most appropriate effluent collection, treatment and disposal system, engineering, hydrological, geotechnical, and environmental studies have been completed which are then assessed against a risk framework. Additional site perched water modelling and geotechnical investigations for winter permeability are in progress with initial results indicating support for the proposed approach. Ongoing monitoring is being conducted for the upcoming winter to validate modelled results.

The outcome of the risk framework process, also identified as a site and soil evaluation, is to recommend the minimum level of treatment required as well as appropriate options for land application systems.

**Table 10: Onsite effluent disposal major considerations**

Characteristic	Recommendation
Low Infiltration Ability	The development site is categorized with a wide range of Soil Categories dependent on location, in this manner, land application area minimum requirements will vary and have been demonstrated throughout this report to meet areas sized for no winter storage.
Separation to Rock/Perched Water	Disposal areas are required to maintain a minimum on 0.6m of vertical setback to impermeable underlying limiting layers and perched water flow pathways.  Current modelled results of these layers have been undertaken to identify at risk locations that may require additional treatment (such as fill) to achieve these setbacks.
Slope	Development slope analysis indicated typically ~10% slope throughout.  Development land application areas are to ensure minimum slopes where possible with engineered solution incorporated into final design to mitigate impact of increased slopes.
Climate	Pan evaporation rates do not exceed rainfall during winter months with land application areas selected for size based on water balance for no storage.
Nutrient Balance	Due to the variance of soil categories throughout the development, a nutrient management plan suited to soil category will be implemented to ensure appropriate application qualities. Nutrient retention of nitrogen and phosphorous is required as a minimum above secondary treatment.
Vegetation	A number of significant flora and vegetation areas are identified throughout the development with the project intent to protect these so that biological diversity and ecological integrity are maintained. Land application systems that minimise clearing and incorporate low impact installation will be assessed in specific design.

The following table outlines the current assessment of different specific characteristics for consideration.



**Table 11: Risk Assessment of Site Characteristics**

Characteristic	Level of Constraint			Assessed Level of Constraint for Site
	Nil or Low	Moderate	High	
<b>General Characteristics</b>				
Climate (difference between average annual rainfall and average pan evaporation, mm/year)	Excess of evaporation over rainfall in the wettest months	Rainfall approximates to evaporation	Excess of rainfall over evaporation in the wettest months	High
Exposure to sun and wind	Full sun and/or high wind or minimal shading and North / North-East / North-West aspect	Dappled light East / West / South-East / South-West aspect	Limited patches of light and little wind to heavily shaded all day and South aspect	Low
Vegetation coverage over the site	Plentiful vegetation with healthy growth and good potential for nutrient uptake Turf or pasture	Limited variety of vegetation	Sparse vegetation or no vegetation, dense forest with little understorey	Moderate
Landslip (or landslip potential)	Nil	Low to moderate	High or Severe	Low
Slope Form (affects water shedding ability)	Hill crests, convex or divergent side-slopes and plains	Straight side-slopes and footslopes	Floodplains, concave or convergent side-slopes and incised channels	Low
Site Drainage (qualitative)	No visible signs or likelihood of dampness, even in wet season	Some signs or likelihood of dampness  Moist soil but no standing water in soil pit.	Wet soil, moisture-loving plants, standing water in pit; water ponding on surface	Moderate
<b>Slope gradient (%):</b>				
(a) for absorption trenches and beds	<5%	5-15%	>15%	Moderate



Characteristic	Level of Constraint			Assessed Level of Constraint for Site
	Nil or Low	Moderate	High	
(b) for surface/ subsurface irrigation	<10%	10-20%	>20%	Low
Erosion (or potential for erosion)	Nil or Low	Moderate	Severe	Low
Fill (imported)	No fill at present or fill is good quality topsoil or minimal fill required	Moderate coverage and good quality fill	Extensive poor-quality fill and variable quality fill	Low
Flood frequency (AEP)	Less than 1 in 100 years	Between 100 and 20 years	More than 1 in 20 years	Low
Privet bore used for household/drinking water purposes	No bores onsite or on neighbouring properties	>30m to the nearest privet bore	<30m to the nearest privet bore	Low
Proximity to water resources	>100m	<100m but reduced setback is supported (refer to <a href="#">Section 5.2.2 of the GSP</a> )	<100m and reduced setback is not supported (refer to <a href="#">Section 5.2.2 of the GSP</a> )	Low
Groundwater (wettest time of the year)	>2m	2.0 – 0.6m need for fill to achieve setbacks	<0.6m fill is not practical to achieve setbacks	Low
Perched water (wettest time of the year)	>2m	2.0 – 0.6m need for fill to achieve setbacks	<0.6m fill is not practical to achieve setbacks	Low
Land area available for LAA	Exceeds the minimum required LAA size of AS1547 or <a href="#">Schedule 2 of the GSP</a>	Meets the minimum required LAA size of AS1547 or <a href="#">Schedule 2 of the GSP</a>	Insufficient area available for LAA as per AS1547 or <a href="#">Schedule 2 of the GSP</a>	Low
Rock outcrops (% of surface)	<10%	10-20%	>20%	-
• Area 1 & 7	<10%	10-20%	>20%	High
• Areas 2 – 6	<10%	10-20%	>20%	Low



Characteristic	Level of Constraint			Assessed Level of Constraint for Site
	Nil or Low	Moderate	High	
Site Drainage(qualitative)	No visible signs or likelihood of dampness, even in wet season	Some signs or likelihood of dampness Moist soil but no standing water in soil pit.	Wet soil, moisture-loving plants, standing water in pit; water ponding on surface	Moderate
Stormwater run-on/run-off	Low likelihood of stormwater run-on/run-off	Moderate likelihood of stormwater run-on/run-off, need for diversionary structures	High likelihood of inundation by stormwater run-on/run-off, diversion not practical	Moderate
Soil profile characteristics				
Soil permeability Category (AS1547)	2 and 3	4 and 5	1 and 6	-
• Area 1 – Surface Rock	2 and 3	4 and 5	1 and 6	High
• Area 2 – Category 6	2 and 3	4 and 5	1 and 6	High
• Area 3 – Category 1	2 and 3	4 and 5	1 and 6	High
• Area 4 – Category 4	2 and 3	4 and 5	1 and 6	Moderate
• Area 5 – Category 2	2 and 3	4 and 5	1 and 6	Low
• Area 6 – Category 5	2 and 3	4 and 5	1 and 6	Moderate
• Area 7 – Shallow Rock	2 and 3	4 and 5	1 and 6	High
Profile depth	>2m	2.0-1.0	< 1.0m	High
Hardpan or bedrock	>1.5m	1.5-0.6m Special design requirements and distribution techniques or soil modification	<0.6m	High



Characteristic	Level of Constraint			Assessed Level of Constraint for Site
	Nil or Low	Moderate	High	
		will be necessary, depends on quality of treated wastewater and type of LAS		
Presence of mottling	None		Extensive	Moderate
Course fragments	< 10%	10-40%	>40%	Low
pH	6-8	4.5-6	<4.5, >8	Low
Electrical Conductivity (ECe)(dS/m)	<0.3	0.3-2	>2	High
Sodicity ESP%	<3	6-8	>8	High
Phosphorus adsorption (mg/kg)	>500	200-500	<200	High



## 4. Wastewater Management System Type and Design

### 4.1 Selection and design of the system

The current recommendations for the minimum output quality of onsite wastewater treatment systems are to align with secondary effluent with reduced nutrients with keen attention to the minimisation of Nitrogen and Phosphorous wherever possible. A summary of the effluent quality is outlined in the figure below as extracted from AS1546.3:2017.

**TABLE 2.2**  
**EFFLUENT COMPLIANCE CRITERIA FOR AN STS WITH NUTRIENT REDUCTION FACILITIES**

Parameter	Secondary effluent with reduced nutrients		Advanced secondary effluent with reduced nutrients	
	90% of samples	Maximum	90% of samples	Maximum
BOD <sub>5</sub>	≤ 20 mg/L	30 mg/L	≤ 10 mg/L	20 mg/L
TSS	≤ 30 mg/L	45 mg/L	≤ 10 mg/L	20 mg/L
<i>E. coli</i> *	≤ 10 cfu/100 mL	30 cfu/100 mL	≤ 10 cfu/100 mL	30 cfu/100 mL
FAC †	Minimum 0.5 mg/L ‡	N/A	Minimum 0.5 mg/L ‡	N/A
Turbidity §	N/A	N/A	N/A	10 NTU
Total N	N/A	15 mg/L	N/A	15 mg/L
Total P	N/A	2 mg/L	N/A	2 mg/L

\* Where disinfection is required.

† Where chlorine disinfection is used.

‡ Minimum level, not 90% of samples.

§ Where UV light is used for disinfection (see Paragraph B3.1).

|| In alignment with NZ OSET NTP 'A grade' nutrient reduction capabilities.

**Figure 6: Secondary Effluent Compliance Criteria**



## 4.1.1 Water Balances

Individual indicative 'worst case' water balance calculations have been undertaken and can be found in Appendix F. The current intent is to demonstrate that the development can retain all wastewater without any winter storage on site.

The following figure demonstrates the general outcome of the land application proposal. Western holiday homes may have the ability to be contained on lot, and ongoing groundwater modelling and geotechnical investigation is underway to determine the outcome.

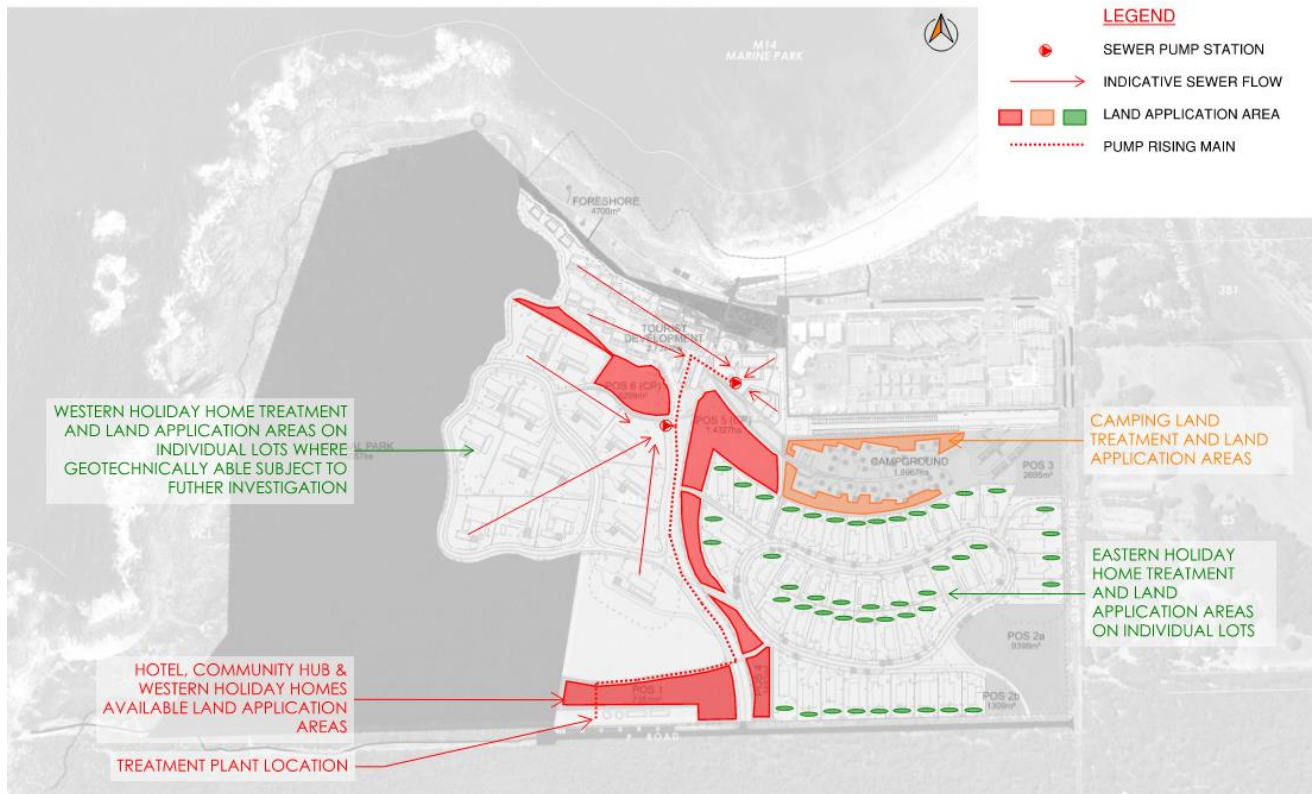


Figure 7: Dripper Type Land Application Areas with no Winter Storage

## 4.2 Siting and Configuration of the Land Application Area

### 4.2.1 Setback Distances

Setback distances from wastewater system are required to help prevent human contact, maintain public amenity and protect sensitive environments.

The development site is proposed to meet or exceed minimum required setback distances outlined in Appendix H.

Where additional modelling and investigation demonstrates interaction with perched water, a minimum vertical clearance will be defined. These investigations are currently ongoing.



## 5. Conclusion and Recommendations

In order to address the items raised within the current assessment, the following system design impacts are proposed for the development.

**Table 12: Onsite effluent disposal major considerations & measures**

Characteristic	Recommendation	System Design Impact
Low Infiltration Ability	The development site is categorized with a wide range of Soil Categories dependent on location, in this manner, land application area minimum requirements will vary and have been demonstrated throughout this report to meet areas sized for no winter storage.	Additional detailed soil evaluations are to be undertaken for specific lots and to ensure correct land application system sizing is selected for each individual property.
Separation to Rock/Perched Water	Disposal areas are required to maintain a minimum of 0.6m of vertical setback to impermeable underlying limiting layers and perched water flow pathways.  Further testing and modelling of these layers are being undertaken to identify at risk locations that may require additional treatment to achieve these setbacks.	On the outcome of modelled and site tested data, land application systems will be limited to ensure three dimensional minimum setback distances are achieved for each individual system.
Slope	Development slope analysis indicated typically ~10% slope throughout.	Development land application areas are to ensure minimum slopes where possible with engineered solutions such as cut off drains etc. incorporated into final design to mitigate impact of increased slopes.
Climate	Pan evaporation rates do not exceed rainfall during winter months with land application areas selected for size based on water balance for no storage. The development hotel and community hub precinct may consider winter storage capacity to reduce land application areas if required.	System design must clearly outline whether winter storage is proposed and how this is to be managed.
Nutrient Balance	Due to the variance of soil categories throughout the development, a nutrient management plan suited to soil category is recommended to ensure appropriate application qualities. Nutrient retention of nitrogen and phosphorous is required as a minimum above secondary treatment.	Nutrient retentive systems are currently recommended as a minimum. Nutrient management plans required for
Vegetation	A number of significant flora and vegetation areas are identified throughout the development with the project intent to protect these so that biological diversity and ecological integrity are maintained. Land application systems that minimise clearing and incorporate low impact installation will be assessed in specific design.	Nutrient retentive systems are currently recommended as a minimum.

When final system design is completed, incorporating all ongoing soil investigations, the design must allow for the most limiting factors with clear and detailed design layouts of treatment systems and land applications areas. This report is a summary of the investigations in progress and will be updated with updated information as it becomes available. The project team welcome any feedback on the information provided herein to allow this report to be updated accordingly.



## 6. References & Related Documents

Beard JS, Beeston GR, Harvey JM, Hopkins AJM, Shepherd DP (2013). The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition. Conservation Science Western Australia 9, 1 pp.1–152, is available from <http://www.dpaw.wa.gov.au/cswajournal>

Department of Agriculture Western Australia (2003). [Evaporation Data for Western Australia. Resource Management Technical Report No. 65.](#)

Department of Planning, Land and Heritage. [State Planning Policy 2.9 - Water resources and the Water Resources Guidelines](#)

Department of Planning, Land and Heritage. Government Sewerage Policy (2019)

<https://www.dplh.wa.gov.au/government-sewerage-policy>

Department of Water and Environmental Regulation. [Water quality Protection Note 25: Land use Compatibility Tables for Public Drinking Water Source Areas.](#)

Health (Miscellaneous Provisions) Act 1911

[https://www.legislation.wa.gov.au/legislation/statutes.nsf/main\\_mrtitle\\_412\\_homepage.html](https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_412_homepage.html)

Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974

[https://www.legislation.wa.gov.au/legislation/statutes.nsf/main\\_mrtitle\\_1581\\_homepage.html](https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_1581_homepage.html)

Standards Australia / Standards New Zealand (2012).

AS/NZS 1547:2012 On-site Domestic wastewater Management.

[Designing and Installing On-Site Wastewater Systems](#)



## 7. Glossary and Definitions

Term/Abbreviation	Definition/Description
AS/NZS	Australian Standards/New Zealand Standards
DLR	Design Loading Rates
DIR	Design Irrigation Rate
DOH	Department of Health
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
Effluent	The liquid discharged from a wastewater treatment unit
Floodplain	The extend of flooding in an area in a one percent (1 in 100) Annual Exceedance Probability flood event for a particular waterway, which includes the floodway and flood fringe areas.
Groundwater	The area of an aquifer in which all pores and fractures are saturated with water. Also known as water in the phreatic zone.
GSP	Government Sewerage Policy 2019
L	Litre
Land Application Area (LAA)	The unencumbered plan area to which treated sewage from an on-site sewage system is distributed for further in-soil treatment and absorption or evaporation. This area is restricted to the distribution of treated sewage.
Land Application System (LAS)	The system used to apply effluent from a wastewater treatment unit into or onto the soil for further in-soil treatment and absorption or evaporation
LG	Local Government
m	Metre
On-site wastewater system	A wastewater treatment and disposal or reuse system that receives treats and applies wastewater to a land application area located within the boundaries of the freehold lot or survey strata within which wastewater was generated.
Primary treatment	The separation of suspended material from sewage in septic tanks, primary settling chambers, or other structures (including those which may be used to treat trade waste) before discharge to either a land application area or secondary treatment process. (For example, septic tanks with leach drains).
Priority areas	The Priority 1, 2, 3 and 3* areas assigned by the Department of Water and Environmental Regulation to guide land use and management decisions.
Public drinking water source area (PDWSA)	Underground water pollution control areas, catchment areas and water reserves that are constituted under the Metropolitan Water Supply, Sewerage, and Drainage Act 1909 or the Country Areas Water Supply Act 1947.
Reticulated sewerage	A network of sewers and associated wastewater treatment plant managed by a sewerage service provider.
Secondary treatment	Microbiological digestion and physical settling and filtering processes and decomposition of sewage constituents following primary treatment
Secondary treatment system	A sewage treatment system which produces treated sewage of secondary standard equal to or less than, i.e., 20 mg/L of Biochemical Oxygen Demand



Term/Abbreviation	Definition/Description
	(BOD), 30 mg/L of Total suspended solids (TSS) and 10 cfu/100 mL of Escherichia (E) coli (for example, an aerobic treatment unit).
Sewage	Any kind of sewage, faecal matter or urine, and any waste composed wholly or in part of liquid
Sewerage service provider	A person or entity that provides a sewerage service in accordance with the Water Services Act 2012.
Site and soil evaluation	An assessment of all relevant constraints and the risks to public health and the environment of an on-site sewage system in accordance with AS/NZS 1547 On-site domestic wastewater management.
SPP 2.9	State Planning Policy 2.9 – Water Resources
Trade waste	Any wastewater, discharged from a business or industry, aside from that which comes from staff amenities or office facilities.
WAPC	The Western Australian Planning Commission
Wastewater	Is consistent to the definition of “sewage”, and does not include stormwater, surface water or ground water of a type that is ordinarily drained from land as part of the provision of a drainage service. This includes trade waste.
Water resources	Includes watercourses, waterways and their estuaries, inlets and floodplains, wetlands, groundwater, surface water, stormwater, and drainage. A water resource includes all aspects of the water resource, including water, organisms and other components and ecosystems that contribute to the physical condition and ecological health of the water resource.
WWTP	Wastewater treatment plant



# 8. Appendix A - Locality Plan





Legend

- Site Boundary
- Cape to Cape Track



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 UK 10199853  
 PRC ID NO. 06000002201607080008  
 Sydney Melbourne Shenzhen Bristol  
 www.mcgregorcoxall.com

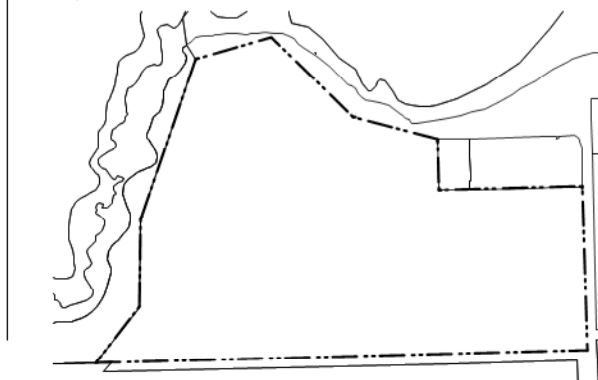
Client  
 Smiths 2014 Pty Ltd

Project Name  
**Smiths Beach Project**

Project No.  
 0848SYD

Address  
 Smiths Beach Rd, Yallingup, WA 6282

Key Plan

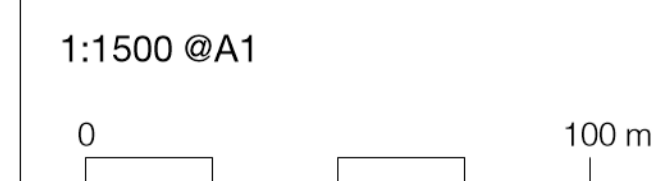


Issue Log

Rev	Revision Description	By / Checked	Date
A	Draft DA	AM/CD	9/07/2021
B	Draft DA	AM/CD	26/08/2021
C	DA ISSUE	AM/CD	10/09/2021

Rev Revision Description By / Checked Date

Scale



All dimensions are in millimetres unless otherwise noted.  
 Do not scale from this drawing.



Phase  
 FOR DEVELOPMENT APPLICATION ONLY

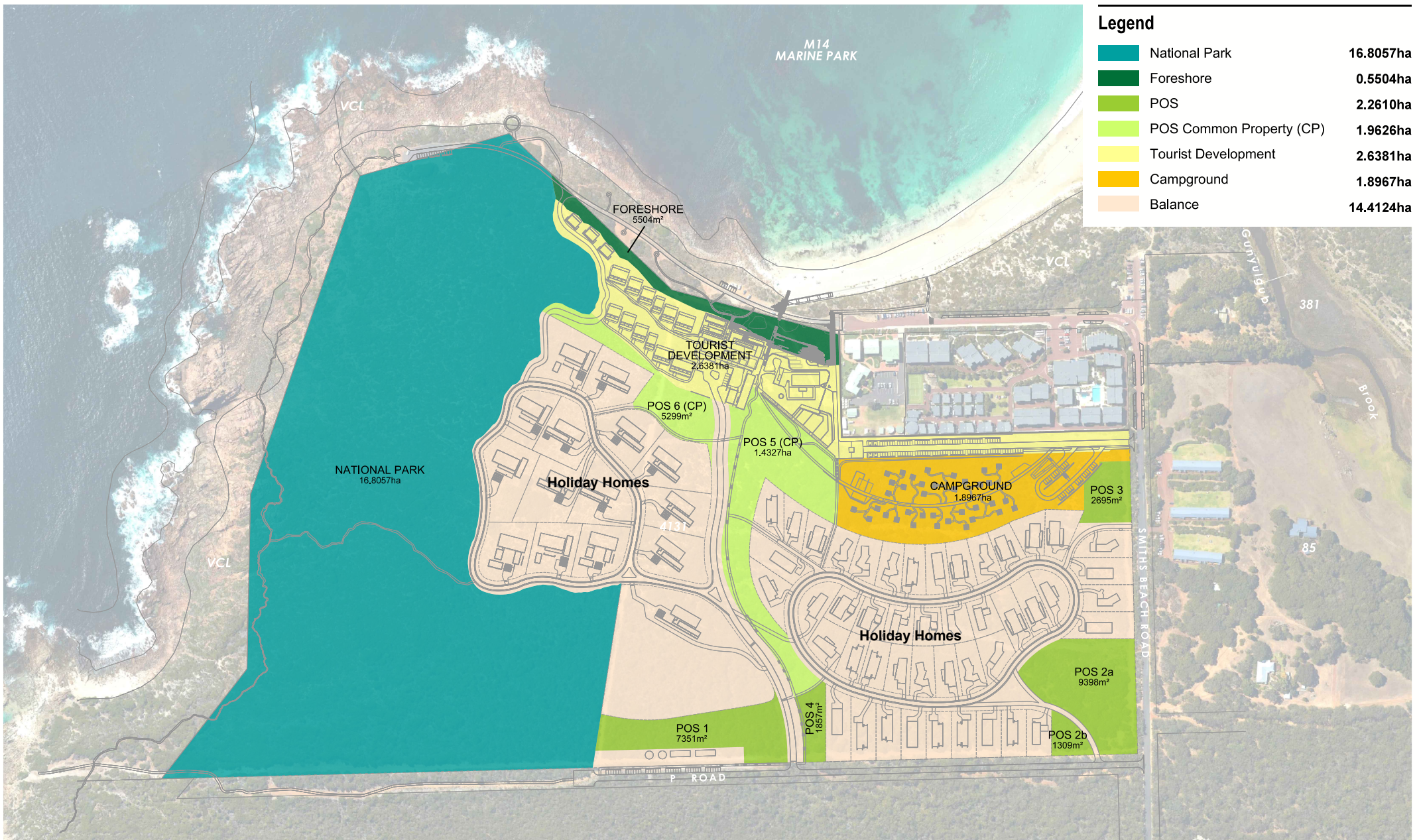
Sheet Title  
 Master Plan

Sheet No.  
 MCG-L-MP-1015

Rev  
 C

9. Appendix B - Tenure Plan





Legend		
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<span style="display:inline-block; width:15px; height:15px; background-color:#90EE90;"></span>	POS	2.2610ha
<span style="display:inline-block; width:15px; height:15px; background-color:#90EE90;"></span>	POS Common Property (CP)	1.9626ha
<span style="display:inline-block; width:15px; height:15px; background-color:#FFFF00;"></span>	Tourist Development	2.6381ha
<span style="display:inline-block; width:15px; height:15px; background-color:#FFA500;"></span>	Campground	1.8967ha
<span style="display:inline-block; width:15px; height:15px; background-color:#FFDAB9;"></span>	Balance	14.4124ha

## Open Space Calculations

SMITHS BEACH

scale / 1:5000@A4 | 1:2500@A2  
 plan / 19/050/0101  
 date / 15/09/2021

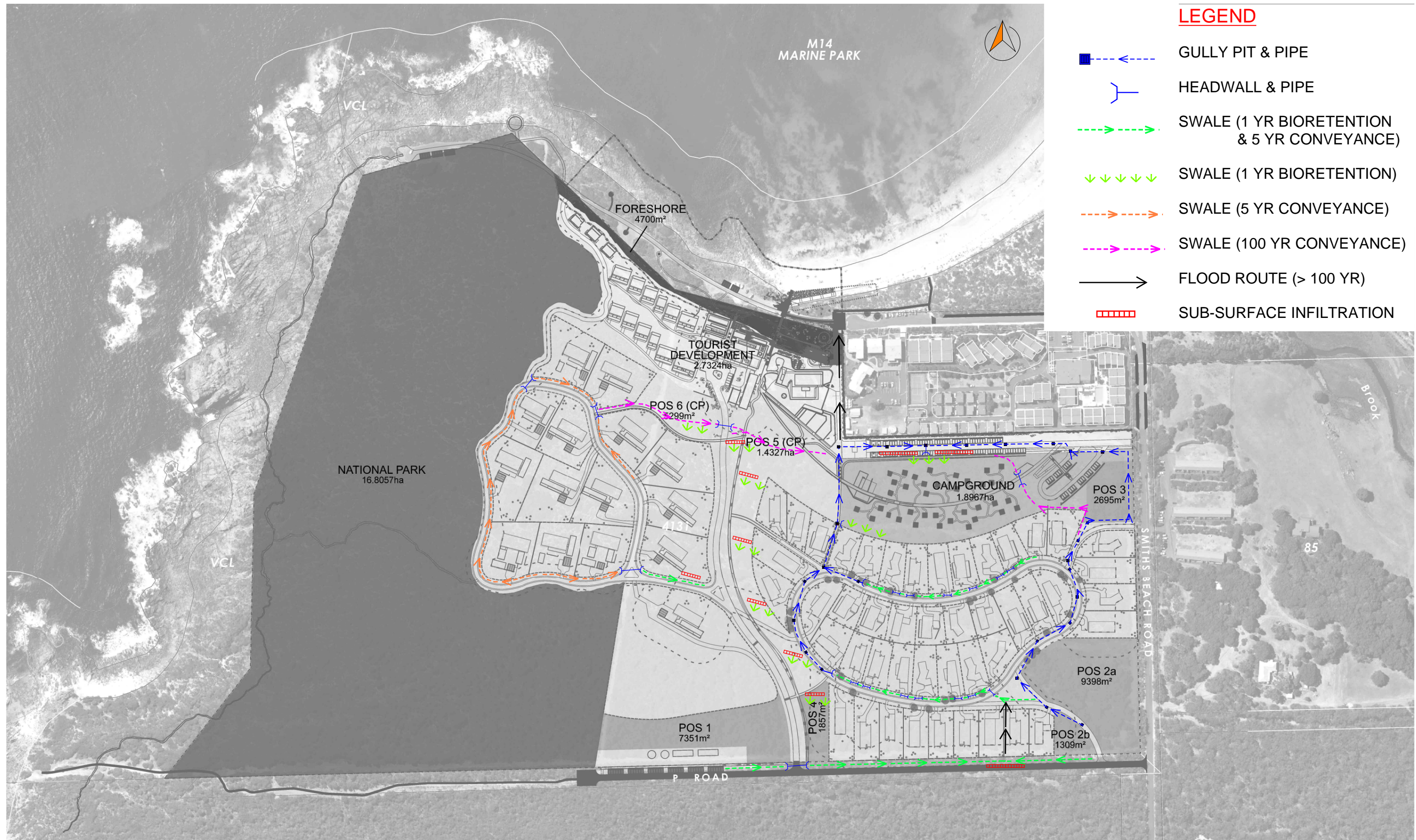
Taylor Burrell Barnett Town Planning & Design  
 Level 7, 160 St Georges Terrace, Perth WA 6000  
 e: admin@tbbplanning.com.au  
 p: (08) 9226 4276



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# 10. Appendix C - Stormwater Concept Plan





**LEGEND**

- GULLY PIT & PIPE
- HEADWALL & PIPE
- SWALE (1 YR BIORETENTION & 5 YR CONVEYANCE)
- SWALE (1 YR BIORETENTION)
- SWALE (5 YR CONVEYANCE)
- SWALE (100 YR CONVEYANCE)
- FLOOD ROUTE (> 100 YR)
- SUB-SURFACE INFILTRATION



Notes  
**SCALE: NTS**

Issue Status  
PRELIMINARY  
NOT FOR CONSTRUCTION

This document is suitable only for the purpose noted above. Use of this document for any other purpose is not permitted.

Client/Project  
  
Project No.

Title  
  
Date  
Reference Sheet  
Figure No.

# 11. Appendix D - Environmental Geology Map





Figure 2 - Environmental Geology Map

Client: Smiths 2014 Pty Ltd  
 Project: Smiths Beach  
 Project Code: 47423

Basemap Service Credits: Aerial Latest (SLIP Locate)  
 Map displayed in EPSG:28350  
 Author: Malone, Daniel (Perth), Stantec (2021-07-14)

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LEGEND

Geoscience

1:50,000 Geological Series

Surface Geology (most areas)

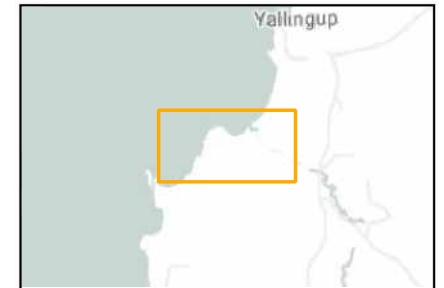
- GN
- LS1
- Msc1
- Ocean
- S1
- S2
- S5
- S7
- Sgm2

WA Local Base Map

Google Terrain Hillshade copy

Google Basemap (SnazzyMap)

Aerial Latest (SLIP Locate)



## 12. Appendix E - Geotechnical Areas



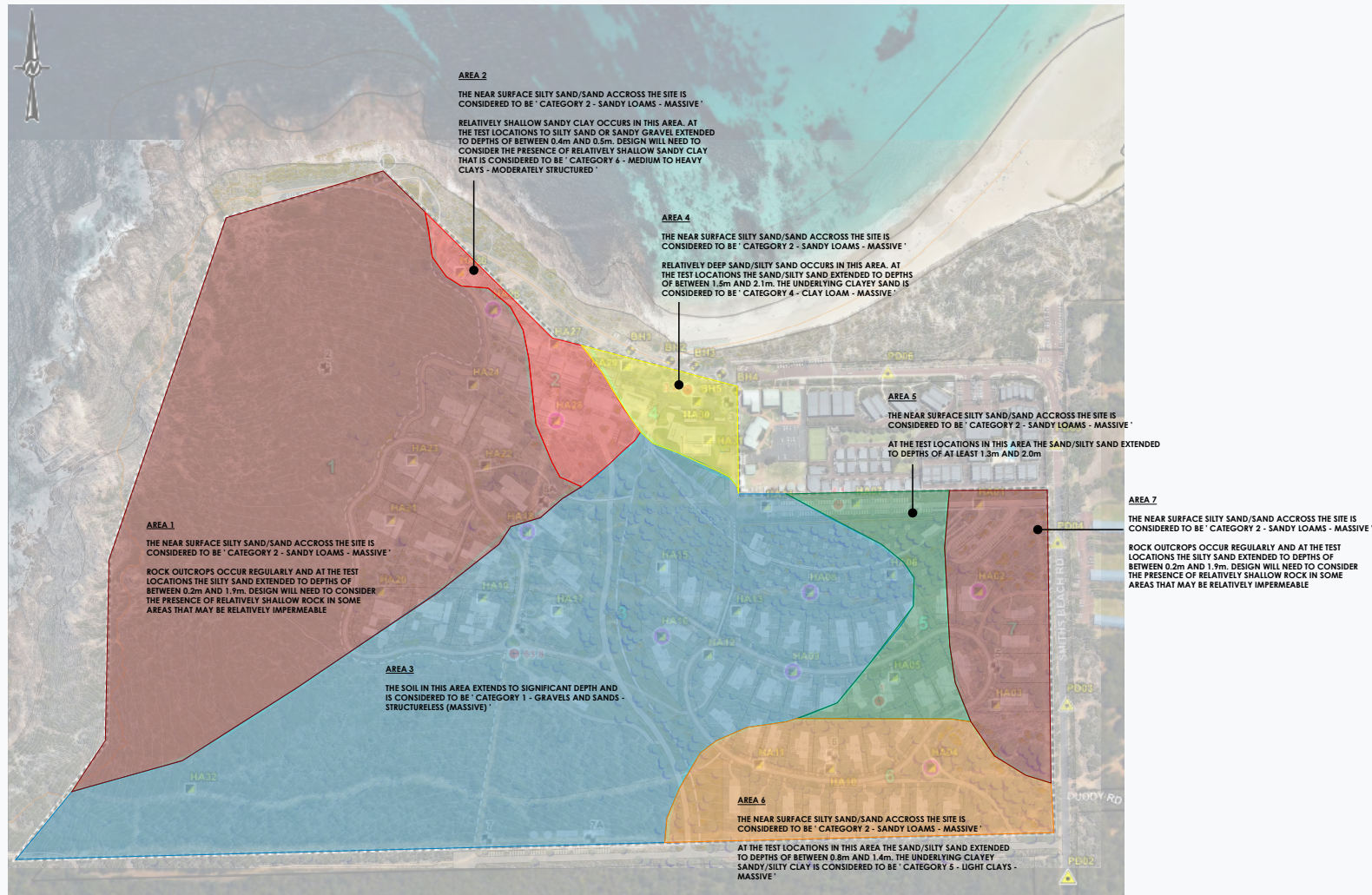


Figure 3 - Geotechnical Areas

Client: Smiths 2014 Pty Ltd  
Project: Smiths Beach  
Project Code: 47423

Basemap Service Credits: Aerial Latest (SLIP Locate)  
Map displayed in EPSG:28350  
Author: Malone, Daniel (Perth), Stantec (2021-07-14)

This document has been prepared based on information provided by others as cited in the data sources. Stantec has not verified the accuracy and/or completeness of this information as shall not be help responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and recipient accepts full responsibility for verifying the accuracy and completeness of the data.



# 13. Appendix F - LAA & Water Balances



# WA Site & Soil Evaluation

## Irrigation area sizing

Please read the attached notes before using this spreadsheet

### Water Balance for Zero Storage

<b>Site Address:</b>	Camping - Category 2 Soil		
<b>Date:</b>	Wednesday, 8 December 2021	<b>Assessor:</b>	

#### INPUT DATA

Design Wastewater Flow	Q	10,360	L/day	Based on maximum potential occupancy and derived from the Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates
Design Irrigation Rate	DIR	5.0	mm/day	Based on soil texture class/permeability and derived from Table M1 of AS/NZS 1547:2012
Nominated Land Application Area	L	3962	m <sup>2</sup>	<sup>1</sup>
Crop Factor	C	0.8-1.0	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type <sup>2</sup>
Rainfall Runoff Factor	RF	0.5	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		Cape Naturaliste		BoM Station and number
Mean Monthly Pan Evaporation Data		Cape Naturaliste		BoM Station and number or data from the Evaporation Data for Western Australia Report ( <a href="https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1058&amp;context=rmt">https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1058&amp;context=rmt</a> )

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	10.9	15	16.2	39.7	97.6	155.1	154.2	118.7	72.3	42.6	26.3	11.2	759.8
Evaporation	E		mm/month	297	257	224	123	87	59	60	69	106	154	203	259	1898
Crop Factor	C		unitless	1.00	1.00	0.90	0.90	0.80	0.80	0.80	0.80	0.90	1.00	1.00	1.00	

#### OUTPUTS

Evapotranspiration	ET	ExC	mm/month	297	257	202	111	70	47	48	55	95	154	203	259	1797.7
Percolation	B	DIRxD	mm/month	155.0	140	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0	1825.0
Outputs		ET+B	mm/month	452.0	397	356.6	260.7	224.6	197.2	203.0	210.2	245.4	309.0	353.0	414.0	3622.7

#### INPUTS

Retained Rainfall	RR	RxRF	mm/month	5.45	7.5	8.1	19.85	48.8	77.55	77.1	59.35	36.15	21.3	13.15	5.6	379.9
Applied Effluent	W	(QxD)/L	mm/month	81.1	73.2	81.1	78.4	81.1	78.4	81.1	81.1	78.4	81.1	78.4	81.1	954.4
Inputs		RR+W	mm/month	86.5	80.7	89.2	98.3	129.9	156.0	158.2	140.4	114.6	102.4	91.6	86.7	1334.3

#### STORAGE CALCULATION

Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-365.5	-316.3	-267.4	-162.4	-94.7	-41.2	-44.8	-69.8	-130.8	-206.6	-261.4	-327.3	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												

#### LAND AREA REQUIRED FOR ZERO STORAGE

		m <sup>2</sup>	719	745	922	1290	1827	2598	2551	2129	1485	1116	915	786		
<b>MINIMUM AREA REQUIRED FOR ZERO STORAGE:</b>			<b>2598</b>	m <sup>2</sup>												

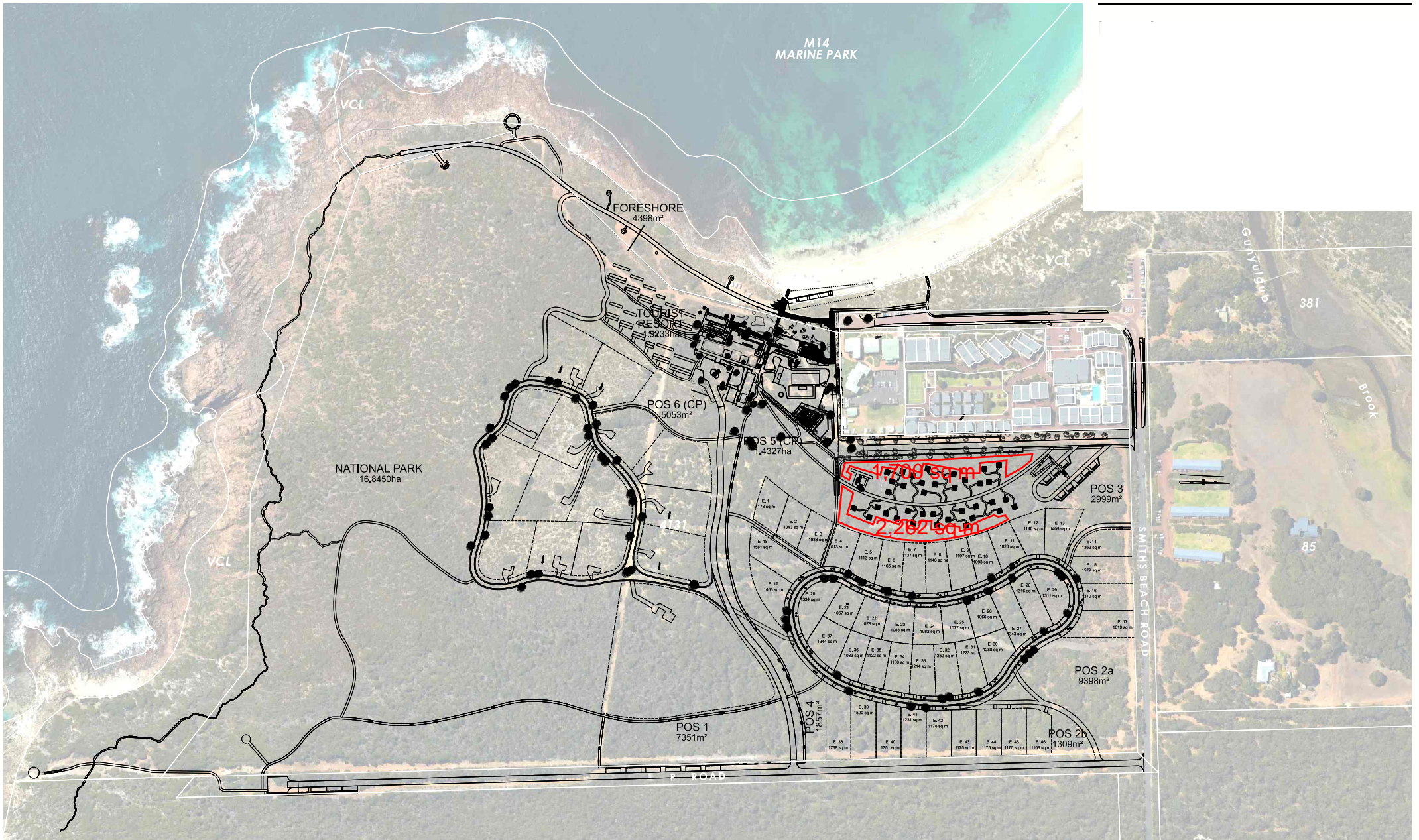
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<span style="background-color: #ffffcc; border: 1px solid black; padding: 2px;">XX</span>	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

#### NOTES

<sup>1</sup> This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

<sup>2</sup> Values selected are suitable for grass in WA



**LAND APPLICATION PLAN**  
SMITHS BEACH

scale / 1:5000@A4 | 1:2500@A2 plan / 19/050/010E  
 0 50 100m date / 16/06/2021

# WA Site & Soil Evaluation

## Irrigation area sizing

Please read the attached notes before using this spreadsheet

### Water Balance for Zero Storage

Site Address: **Commercial & Western Holiday Homes - Category 1 Soil**

Date: **Wednesday, 22 December 2021** Assessor:

#### INPUT DATA

Design Wastewater Flow	Q	84,025	L/day	Based on maximum potential occupancy and derived from the Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates
Design Irrigation Rate	DIR	5.0	mm/day	Based on soil texture class/permeability and derived from Table M1 of AS/NZS 1547:2012
Nominated Land Application Area	L	21111	m <sup>2</sup>	<sup>1</sup>
Crop Factor	C	0.8-1.0	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type <sup>2</sup>
Rainfall Runoff Factor	RF	0.5	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		Cape Naturaliste		
Mean Monthly Pan Evaporation Data		Cape Naturaliste		

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	10.9	15	16.2	39.7	97.6	155.1	154.2	118.7	72.3	42.6	26.3	11.2	759.8
Evaporation	E		mm/month	297	257	224	123	87	59	60	69	106	154	203	259	1898
Crop Factor	C		unitless	1.00	1.00	0.90	0.90	0.80	0.80	0.80	0.80	0.90	1.00	1.00	1.00	

#### OUTPUTS

Evapotranspiration	ET	ExC	mm/month	297	257	202	111	70	47	48	55	95	154	203	259	1797.7
Percolation	B	DIRxD	mm/month	155.0	140	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0	1825.0
Outputs		ET+B	mm/month	452.0	397	356.6	260.7	224.6	197.2	203.0	210.2	245.4	309.0	353.0	414.0	3622.7

#### INPUTS

Retained Rainfall	RR	RxRF	mm/month	5.45	7.5	8.1	19.85	48.8	77.55	77.1	59.35	36.15	21.3	13.15	5.6	379.9
Applied Effluent	W	(QxD)/L	mm/month	123.4	111.4	123.4	119.4	123.4	119.4	123.4	123.4	119.4	123.4	119.4	123.4	1452.8
Inputs		RR+W	mm/month	128.8	118.9	131.5	139.3	172.2	197.0	200.5	182.7	155.6	144.7	132.6	129.0	1832.7

#### STORAGE CALCULATION

Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-323.2	-278.1	-225.1	-121.4	-52.4	-0.2	-2.5	-27.5	-89.8	-164.3	-220.4	-285.0	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												

#### LAND AREA REQUIRED FOR ZERO STORAGE

			m <sup>2</sup>	5833	6040	7474	10466	14817	21068	20689	17267	12047	9054	7417	6378	
--	--	--	----------------	------	------	------	-------	-------	-------	-------	-------	-------	------	------	------	--

#### MINIMUM AREA REQUIRED FOR ZERO STORAGE:

**21068** m<sup>2</sup>

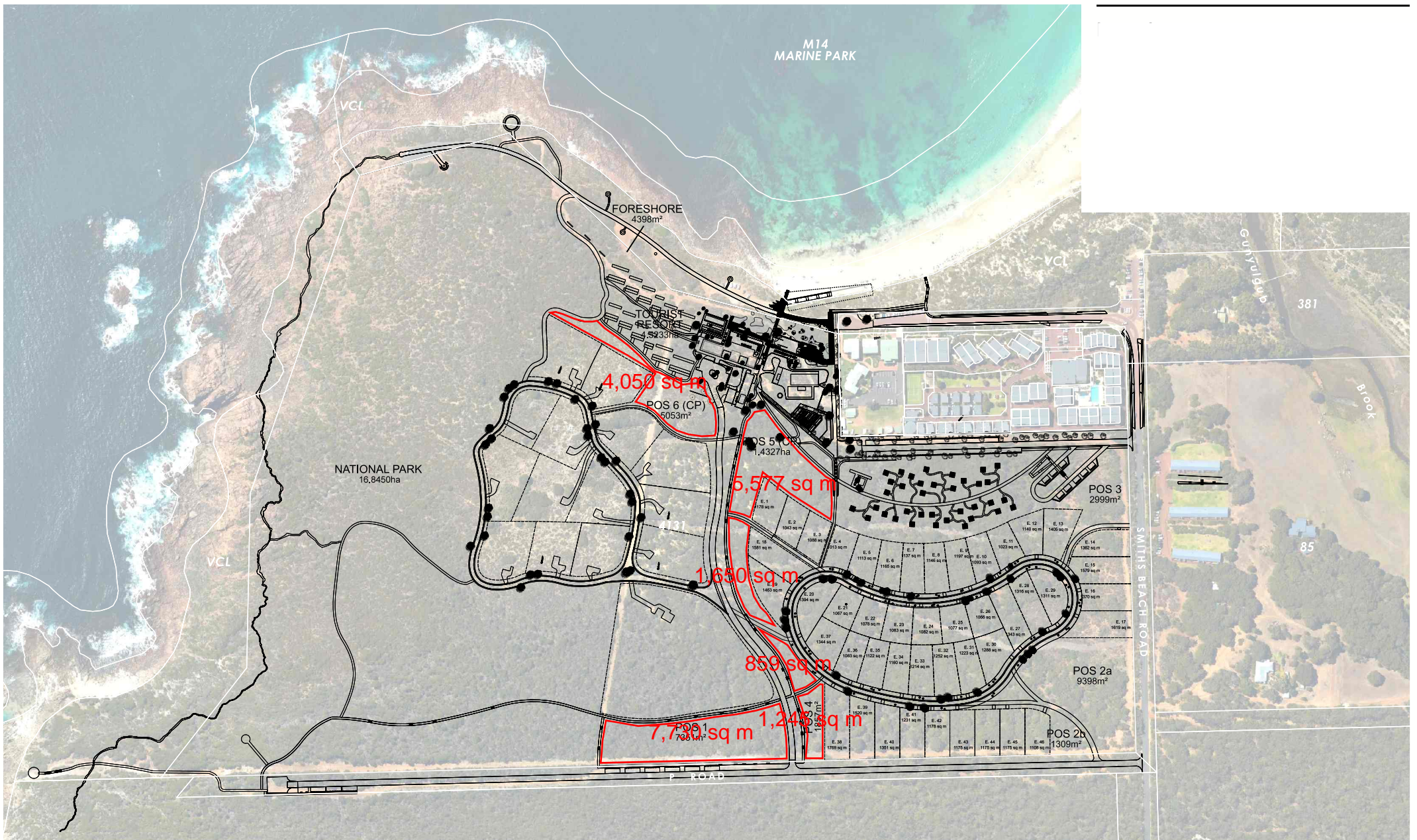
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<span style="background-color: #ffffcc; border: 1px solid black; padding: 2px;">XX</span>	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

#### NOTES

<sup>1</sup> This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

<sup>2</sup> Values selected are suitable for grass in WA



**LAND APPLICATION PLAN**  
SMITHS BEACH

scale / 1:5000@A4 | 1:2500@A2 plan / 19/050/010E  
 0 50 100m date / 16/06/2021

# WA Site & Soil Evaluation

## Irrigation area sizing

Please read the attached notes before using this spreadsheet

### Water Balance for Zero Storage

<b>Site Address:</b>	Eastern Holiday Homes - Cat 1 Soil Example		
<b>Date:</b>	Wednesday, 8 December 2021	<b>Assessor:</b>	

#### INPUT DATA

Design Wastewater Flow	Q	829	L/day	Based on maximum potential occupancy and derived from the Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates
Design Irrigation Rate	DIR	5.0	mm/day	Based on soil texture class/permeability and derived from Table M1 of AS/NZS 1547:2012
Nominated Land Application Area	L	250	m <sup>2</sup>	<sup>1</sup>
Crop Factor	C	0.8-1.0	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type <sup>2</sup>
Rainfall Runoff Factor	RF	0.5	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		Cape Naturaliste		BoM Station and number
Mean Monthly Pan Evaporation Data		Cape Naturaliste		BoM Station and number or data from the Evaporation Data for Western Australia Report ( <a href="https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1058&amp;context=rmt">https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1058&amp;context=rmt</a> )

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	10.9	15	16.2	39.7	97.6	155.1	154.2	118.7	72.3	42.6	26.3	11.2	759.8
Evaporation	E		mm/month	297	257	224	123	87	59	60	69	106	154	203	259	1898
Crop Factor	C		unitless	1.00	1.00	0.90	0.90	0.80	0.80	0.80	0.80	0.90	1.00	1.00	1.00	

#### OUTPUTS

Evapotranspiration	ET	ExC	mm/month	297	257	202	111	70	47	48	55	95	154	203	259	1797.7
Percolation	B	DIRxD	mm/month	155.0	140	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0	1825.0
Outputs		ET+B	mm/month	452.0	397	356.6	260.7	224.6	197.2	203.0	210.2	245.4	309.0	353.0	414.0	3622.7

#### INPUTS

Retained Rainfall	RR	RxRF	mm/month	5.45	7.5	8.1	19.85	48.8	77.55	77.1	59.35	36.15	21.3	13.15	5.6	379.9
Applied Effluent	W	(QxD)/L	mm/month	102.8	92.8	102.8	99.5	102.8	99.5	102.8	102.8	99.5	102.8	99.5	102.8	1210.3
Inputs		RR+W	mm/month	108.2	100.3	110.9	119.3	151.6	177.0	179.9	162.1	135.6	124.1	112.6	108.4	1590.2

#### STORAGE CALCULATION

Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-343.8	-296.7	-245.7	-141.4	-73.0	-20.2	-23.1	-48.1	-109.8	-184.9	-240.4	-305.6	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												

#### LAND AREA REQUIRED FOR ZERO STORAGE

			m <sup>2</sup>	58	60	74	103	146	208	204	170	119	89	73	63	
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#### MINIMUM AREA REQUIRED FOR ZERO STORAGE:

**208** m<sup>2</sup>

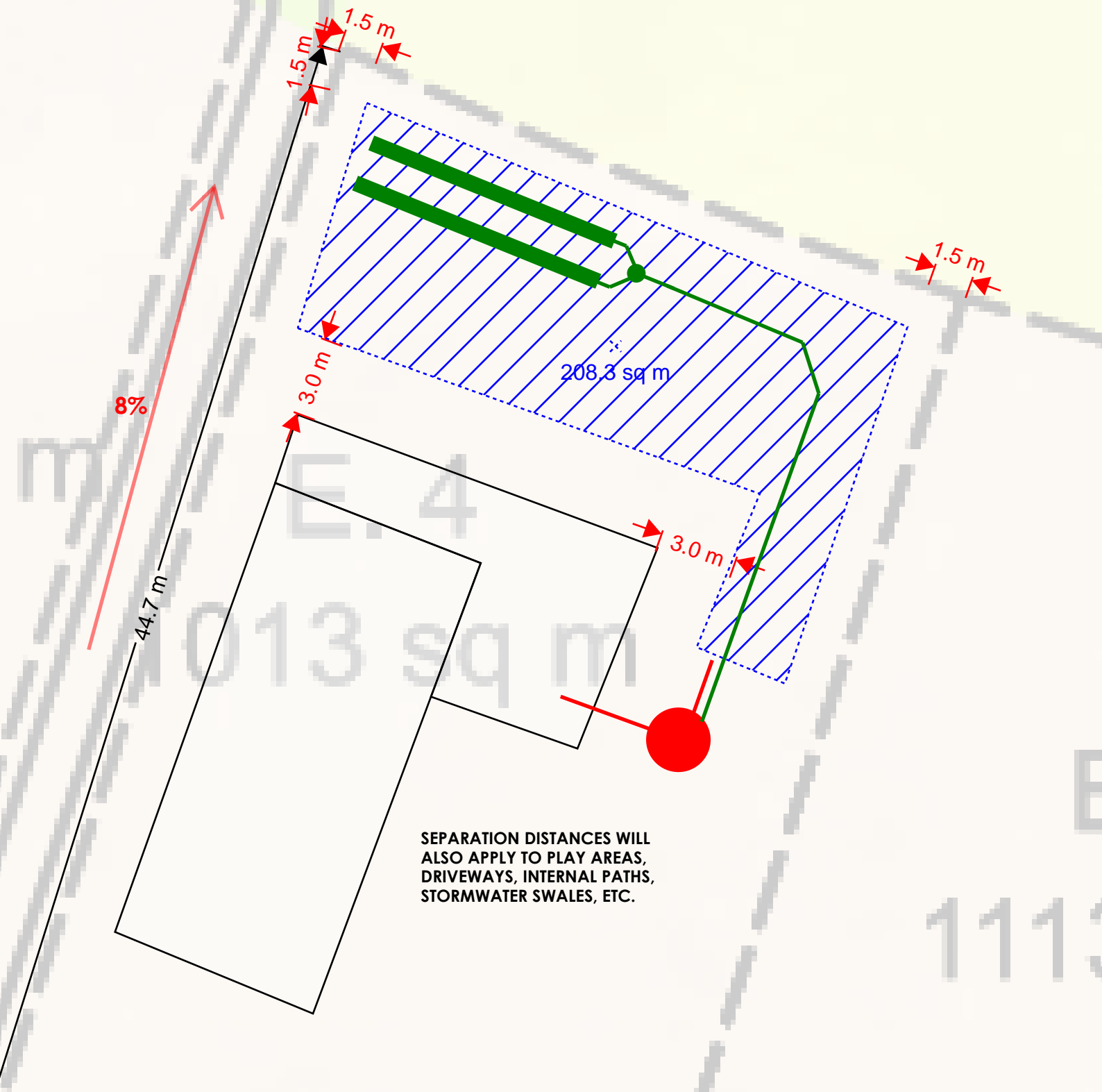
#### CELLS

<span style="background-color: #e0f0ff; border: 1px solid black; padding: 2px;"> </span>	Please enter data in blue cells
<span style="background-color: #ffe0e0; border: 1px solid black; padding: 2px;">XX</span>	Enter available Land Application Area
<span style="background-color: #ffffe0; border: 1px solid black; padding: 2px;">XX</span>	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

#### NOTES

<sup>1</sup> This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

<sup>2</sup> Values selected are suitable for grass in WA



SEPARATION DISTANCES WILL ALSO APPLY TO PLAY AREAS, DRIVEWAYS, INTERNAL PATHS, STORMWATER SWALES, ETC.

4 BEDROOMS  
829 L/Day LOADING  
>3.0 m/day PERMEABILITY  
CAT 1 SOIL

SINGLE TANK STS SHOWN

**DRIPPER IRRIGATION OPTION**  
0 - 10% SLOPE = 0% REDUCTION IN DIR  
DIR = 5 mm/day  
AREA REQUIRED = 208 m<sup>2</sup>

**TRENCH DRAIN OPTION**  
LAND REQUIRED TO BE LEVELED IN LEACH DRAIN LOCATION  
DLR = 50 mm/day  
IA ASSUMED = 1.5  
LENGTH OF LEACH DRAIN REQUIRED = 11m (2 x 12m TYPICAL)

# WA Site & Soil Evaluation

## Irrigation area sizing

Please read the attached notes before using this spreadsheet

### Water Balance for Zero Storage

<b>Site Address:</b>	Eastern Holiday Homes - Cat 5 Soil Example		
<b>Date:</b>	Wednesday, 8 December 2021	<b>Assessor:</b>	

#### INPUT DATA

Design Wastewater Flow	Q	829	L/day	Based on maximum potential occupancy and derived from the Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates
Design Irrigation Rate	DIR	3.0	mm/day	Based on soil texture class/permeability and derived from Table M1 of AS/NZS 1547:2012
Nominated Land Application Area	L	427	m <sup>2</sup>	<sup>1</sup>
Crop Factor	C	0.8-1.0	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type <sup>2</sup>
Rainfall Runoff Factor	RF	0.5	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		Cape Naturaliste		BoM Station and number
Mean Monthly Pan Evaporation Data		Cape Naturaliste		BoM Station and number or data from the Evaporation Data for Western Australia Report ( <a href="https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1058&amp;context=rmt">https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1058&amp;context=rmt</a> )

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	10.9	15	16.2	39.7	97.6	155.1	154.2	118.7	72.3	42.6	26.3	11.2	759.8
Evaporation	E		mm/month	297	257	224	123	87	59	60	69	106	154	203	259	1898
Crop Factor	C		unitless	1.00	1.00	0.90	0.90	0.80	0.80	0.80	0.80	0.90	1.00	1.00	1.00	

#### OUTPUTS

Evapotranspiration	ET	ExC	mm/month	297	257	202	111	70	47	48	55	95	154	203	259	1797.7
Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	1095.0
Outputs		ET+B	mm/month	390.0	341	294.6	200.7	162.6	137.2	141.0	148.2	185.4	247.0	293.0	352.0	2892.7

#### INPUTS

Retained Rainfall	RR	RxRF	mm/month	5.45	7.5	8.1	19.85	48.8	77.55	77.1	59.35	36.15	21.3	13.15	5.6	379.9
Applied Effluent	W	(QxD)/L	mm/month	60.2	54.4	60.2	58.2	60.2	58.2	60.2	60.2	58.2	60.2	58.2	60.2	708.6
Inputs		RR+W	mm/month	65.6	61.9	68.3	78.1	109.0	135.8	137.3	119.5	94.4	81.5	71.4	65.8	1088.5

#### STORAGE CALCULATION

Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-324.4	-279.1	-226.3	-122.6	-53.6	-1.4	-3.7	-28.7	-91.0	-165.5	-221.6	-286.2	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												

#### LAND AREA REQUIRED FOR ZERO STORAGE

			m <sup>2</sup>	67	70	90	138	226	417	402	289	167	114	89	74	
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#### MINIMUM AREA REQUIRED FOR ZERO STORAGE:

**417** m<sup>2</sup>

#### CELLS

<span style="background-color: #e0f0ff; border: 1px solid black; padding: 2px;"> </span>	Please enter data in blue cells
<span style="background-color: #ffe0e0; border: 1px solid black; padding: 2px;">XX</span>	Enter available Land Application Area
<span style="background-color: #ffff00; border: 1px solid black; padding: 2px;">XX</span>	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

#### NOTES

<sup>1</sup> This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

<sup>2</sup> Values selected are suitable for grass in WA

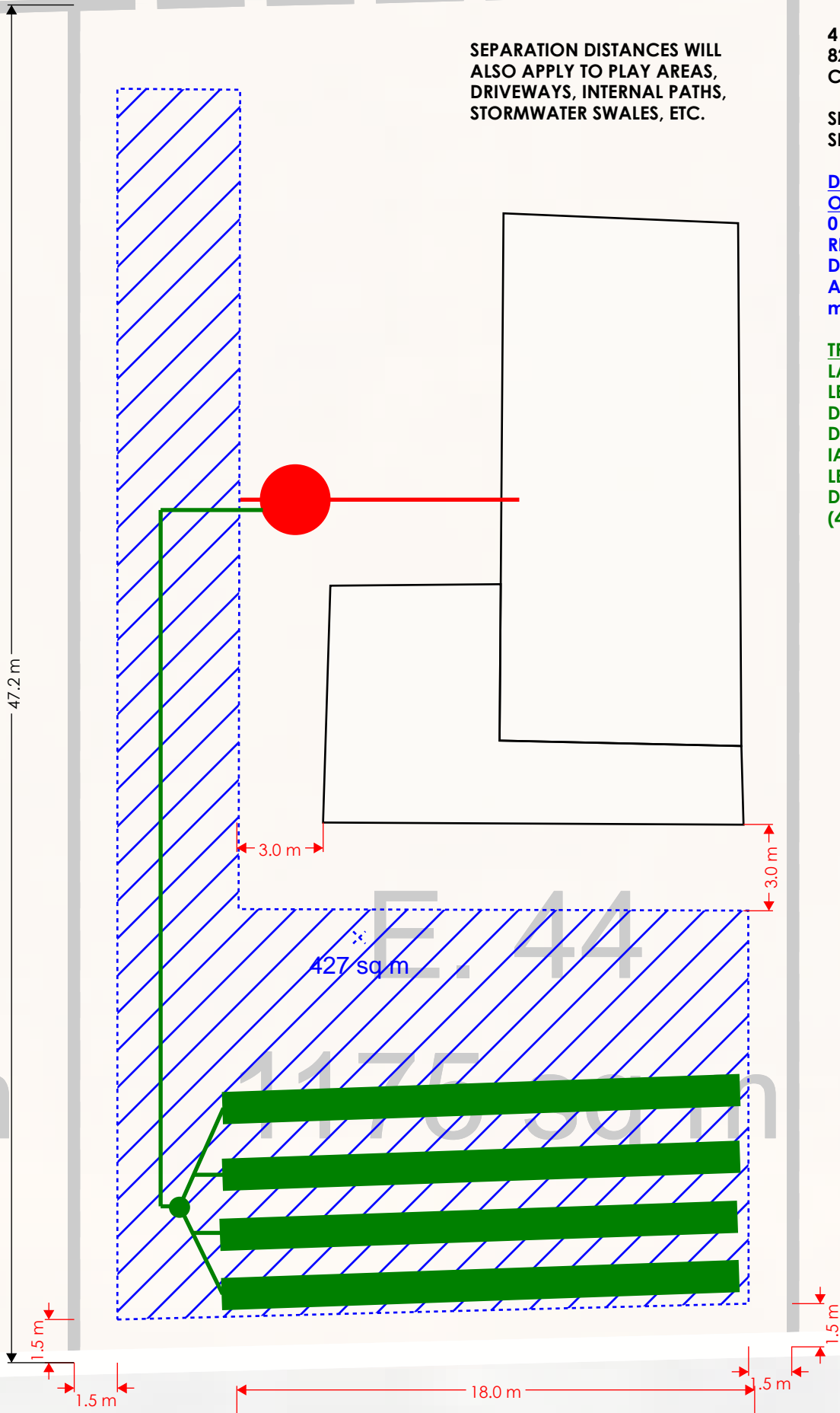
SEPARATION DISTANCES WILL ALSO APPLY TO PLAY AREAS, DRIVEWAYS, INTERNAL PATHS, STORMWATER SWALES, ETC.

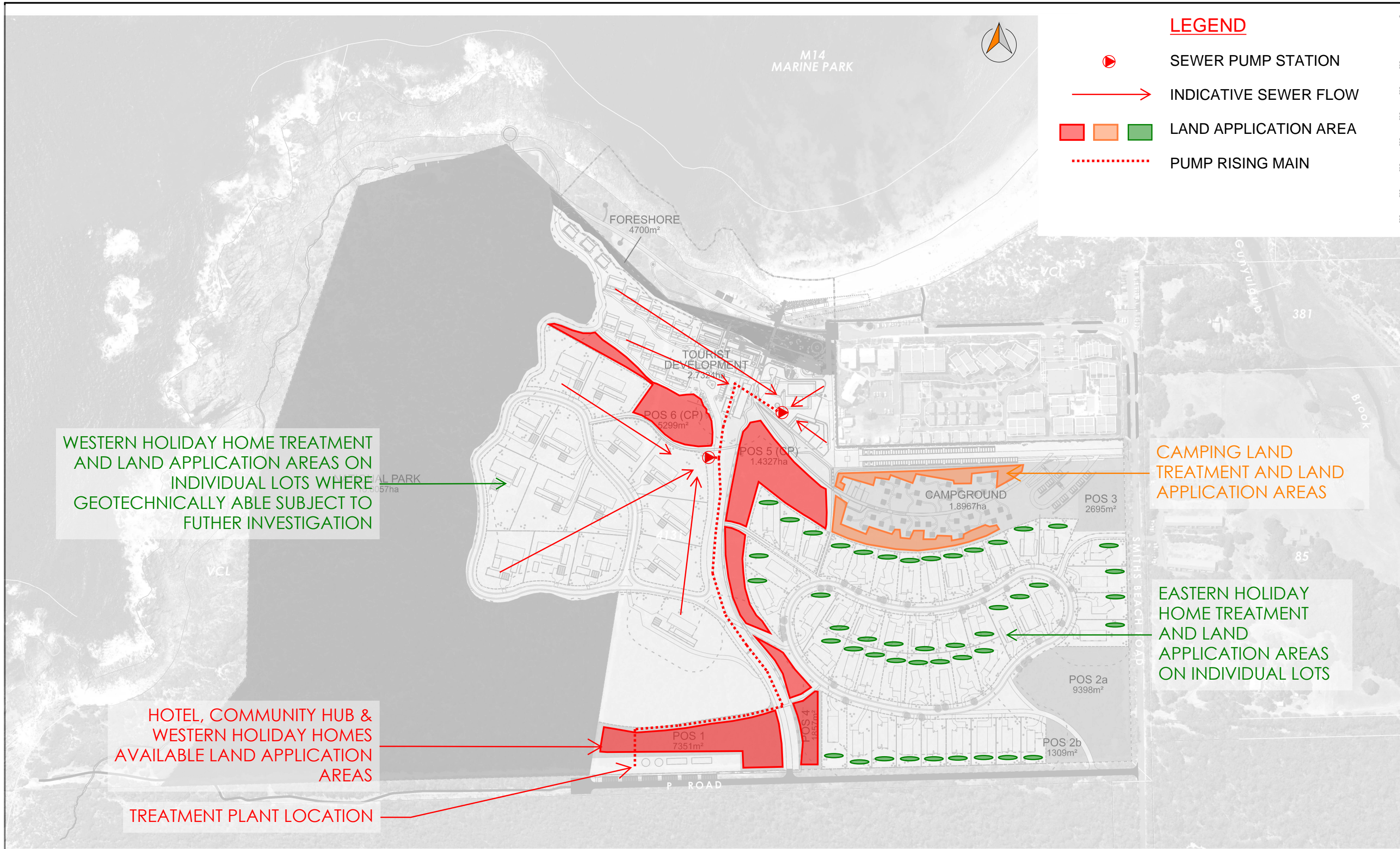
4 BEDROOMS  
829 L/Day LOADING  
CAT 5 SOIL

SINGLE TANK STS SHOWN

**DRIPPER IRRIGATION OPTION**  
0 - 10% SLOPE = 0%  
REDUCTION IN DIR  
DIR/DLR = 3 mm/day  
AREA REQUIRED = 417 m<sup>2</sup>

**TRENCH DRAIN OPTION**  
LAND REQUIRED TO BE LEVELED IN LEACH  
DRAIN LOCATION  
DIR/DLR = 12 mm/day  
IA ASSUMED = 2.0  
LENGTH OF LEACH  
DRAIN REQUIRED = 35m  
(4 x 18m TYPICAL)





Notes  
**SCALE: NTS**

Issue Status  
PRELIMINARY  
NOT FOR CONSTRUCTION  
This document is suitable only for the purpose noted above. Use of this document for any other purpose is not permitted.

Client/Project  
Project No.

Title  
Date  
Reference Sheet  
Figure No.

# 14. Appendix G - Geotechnical Investigation Report



# 15. Appendix H - Horizontal & Vertical Setback Distance Comments

Site Feature	Setback Distance, m	Project Comments
Horizontal setback distances		
Treatment tanks to buildings, property boundaries, driveways, paths, and other tanks	1.2	
Tranches, beds and soak wells to boundary, building, tanks, and other land application systems	1.8	
Tranches, beds, and soak wells to trafficable areas	1.2	
Any land application system to wells, stream, private bores or underground source of water intended for human consumption	30	N/A
Tranches, beds and soak wells to subsoil drainage or open drainage channel (as per <a href="#">Section 5.2.2 of the GSP</a> a separation of 100m is required if there is discharge into a waterway or significant wetland without treatment of the discharge)	6.0	
Spray Irrigation:		
• Boundaries, buildings, driveways etc.	1.8	
• Sub-soil and open drain	6.0	
• Swimming pool	3.0	
• Treatment tanks	1.2	
Subsurface Dripper:		
• Boundaries, buildings, treatment tanks, driveways etc.	0.5	
• Sub-soil and open drain	3.0	
• Swimming pool	2.0	
• Garden bore	10.0	N/A
On-site wastewater system to water resources (for more details refer to <a href="#">Section 5.2.2 of the GSP</a> )	100	N/A
On-site wastewater system must not be located within any area subject to inundation and/or flooding in a 10 per cent Annual Exceedance Probability (AEP) rainfall event		
Vertical setback distances		
Discharge point of the on-site wastewater system to the highest known groundwater level:		
• PDWSA	2.0	Applicable for Perched Water investigations
• Sensitive water resource areas	1.5	
• All other areas -		
- Sands	1.5	
- Gravels	1.0	
- Loams and heavy soils	0.6	
Hardpan or bedrock (depends on quality of treated wastewater and type of LAS)	0.6-1.5	1.5m to be achieved



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