SITE AND SOIL EVALUATION
(On-Site Effluent Disposal)
Lot 304 Sunday Island Bay
Dirk Hartog Island.

Prepared for

DHI Developments Pty Ltd

for submission to

Shire of Shark Bay

by

Land Assessment Pty Ltd

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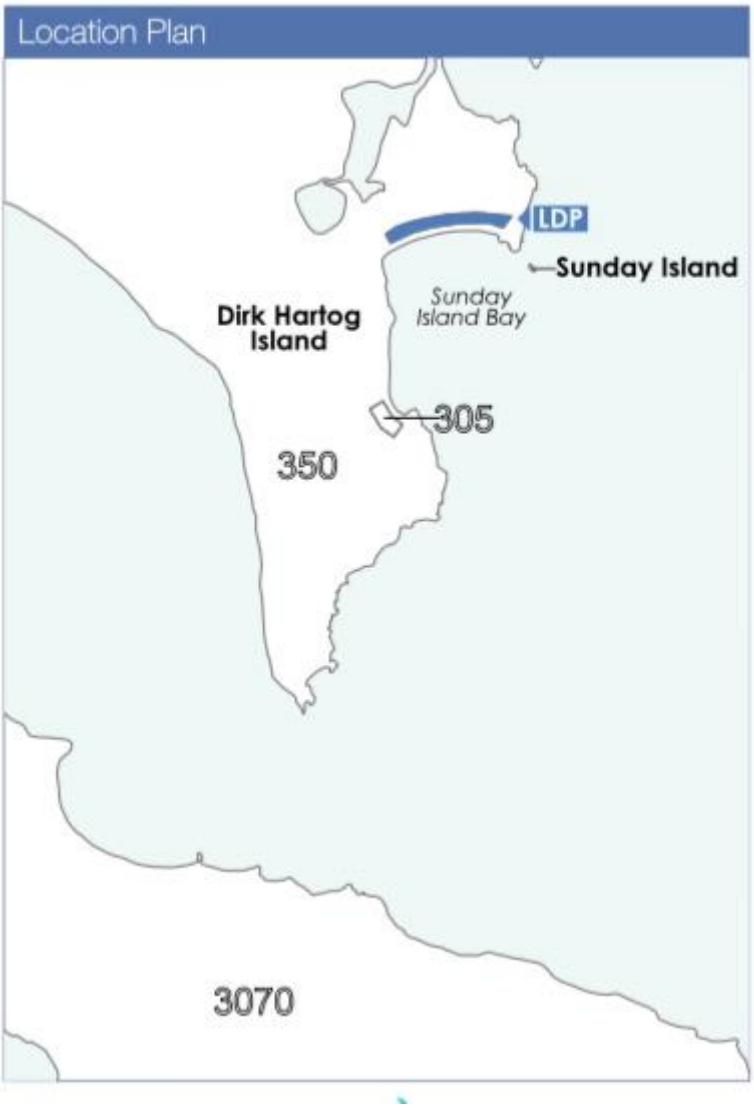
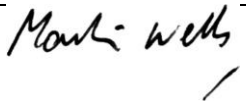
1.0 PROJECT DEFINITION	
1.1 Background and Objective.	A draft Local Development Plan (LDP) has been prepared for Lot 304 Sunday Island Bay by planners Taylor Burrell Barnett on behalf of DHI Developments Pty Ltd (Attachment A). The proposal is for an eco-tourism leisure development ultimately comprised of 33 short-stay accommodation units to be managed as part of a coordinated leisure accommodation destination over a staged development period. At the initial stage, eight accommodation units are planned (numbered 8 – 13, 17 and 23 within the LDP in Attachment A). Each accommodation unit is proposed to operate independently for the provision of power and water, and for the on-site treatment of sewage and disposal of effluent. In response to submission of the draft LPP the Shire of Shark Bay have advised, among other matters, that a 'Site and Soil Evaluation' (SSE) in accordance with the Government Sewerage Policy (State Government of Western Australia 2019) is required to be addressed as part of the LDP. The objective of this report is to address the SSE requirement and determine the capability of Lot 304 to accommodate systems for on-site effluent disposal without endangering public health or the environment. This is to be in the context of the entire proposed development, but with a focus on the eight initial proposed accommodation units.
1.2 Location	The subject land of the LDP, Lot 304 Sunday Island Bay, is an isolated 11.295 ha area of freehold land located on the south east coast of Dirk Hartog Island within the Shire of Shark Bay. Lot 304 occurs on the edge of the Dirk Island National Park and the Shark Bay Marine Park, both of which are included within the boundary of the Shark Bay World Heritage Area. Access to Dirk Hartog Island is via private boat (approx. 35 km from Denham), a commercial barge service from near Steep Point, or by light aircraft charter. A high clearance four-wheel drive vehicle is required to drive on the island, including access to Lot 304.

	 **FIGURE 1: LOCATION OF LOT 304**
1.3 Local Planning Context	Shire of Shark Bay (LPS No 4) Special Use Zone SU14 The objective of SU14 is to provide for eco-tourism development. A Local Development Plan is required, and no subdivision is permitted.
1.4 Proponent's preferred system/s	Septic tanks with leach drains, with Aerobic Treatment Units as the proponent's second preference.

1.5 Expected Wastewater Volume	Based on information provided within the proponent's *Sunday Island Bay Environmental Report* (Hypermarket Pty Ltd 2014) it is expected that the accommodation units will be short-stay facilities each able to cater for up to a maximum of eight persons. Most commonly however the expected accommodation numbers are 2 – 4 persons (i.e. 3) per unit (G Wardle, DHI Developments Pty Ltd, pers comm). The Department of Health's factsheet *Supplement to Regulation 29 and Schedule 9 – Wastewater system loading rates* (Attachment B) provides designers of wastewater disposal systems with predicted human waste loading rates for various land use types. For ecotourism accommodation facilities the expected wastewater volume (blackwater and grey water combined) is 140 L per person per day, that is **1120 L per unit per day (scenario 1 based on absolute maximum) or 420 L per day (scenario 2 based on the most commonly expected scenario).** It should be noted that each accommodation unit is proposed to operate independently in relation to wastewater management and, in contrast to residential premises, they are not occupied all year round. Based on information provided within the proponent's *Sunday Island Bay Environmental Report* (Hypermarket Pty Ltd 2014) the anticipated maximum occupancy across the site (Lot 304) at any one time is 60%, and most visitation will occur between February and October (0.66 of year). **The cumulative wastewater volume per year for all 33 units is therefore 14,636 L (scenario 1 based on absolute maximum) or 5,489 L per day (based on the most commonly expected scenario).** (i.e. Scenario 1 = 33 X 1120 X 0.6 X 0.66 and, Scenario 2 = 33 X 420 X 0.6 X 0.66)
1.6 Intended Water Supply	The proponent's *Sunday Island Bay Environmental Report* (Hypermarket Pty Ltd 2014) reports that water for the operation of the short-term accommodation units is to be provided from a combination of • Rainwater – harvested from each unit's roof runoff, • Desalinated ocean water, and • Groundwater – pumped from existing wells at either 'West Wells', or 'Two Wells' with both of these sites located some kilometers away from Lot 304. The use of brackish (non-potable) groundwater for toilet flushing is not a constraint for systems based on septic tanks or ATUs.

2.0 SITE EVALUATOR DETAILS	
Name & Company	Martin Wells Land Assessment Pty Ltd ABN: 30 759 556 427
Qualifications & Experience	B Agric Sc (1st hons) 30 years Soil Survey and Land Evaluation including; Eight years with the former Department of Agriculture developing land capability assessment systems and undertaking land resource surveys (including coastal areas within the Shire of Carnarvon). Twenty two years as an independent consultant focussing on environmental impacts of land development requiring on-site effluent disposal - including consulting to Parks and Wildlife section of DBCA for development of sewage management options for tourism facilities within various WA coastal parks and reserves at Wedge and Grey (Shire of Dandaragan), William Bay NP (Shire of Denmark) and Lucky Bay (Shire of Esperance).
Contact Details	Unit 5, 27 York St SUBIACO WA 6008 P.O. Box 117 SUBIACO WA 6008 Mob: 041 7900 724 landass@iinet.net.au www.landassessment.com.au
Disclaimer	This report has been prepared for DHI Developments Pty Ltd and remains the property of Land Assessment Pty Ltd. It has been prepared to address the requirements of the Government Sewerage Policy for a Site and Soil Evaluation in general accordance with the scope of such as outlined in AS/NZS 154,7 and with consideration of the stage of the development proposal in the planning process. The report is based on this consultant's research and field investigation March 22, 23), plus information extracted from the client's environmental report (Hypermarket Pty Ltd 2014). Any conclusions drawn or recommendations made in the report are done in good faith and no responsibility is taken for how information in the report is subsequently used by others.
Signature	

3.0 PROJECT AREA OVERVIEW

3.1 Geology

Playford et al (2013) report the geology of Dirk Hartog Island consists of sand dunes of Holocene to late Pleistocene age overlying Pleistocene eolian limestone (Tamala Limestone). The Tamala Limestone forms precipitous cliffs, up to 150 m high on the west coast, and discontinuous cliffs and headlands, up to 30 m high, on the east coast.

The sand dunes which mantle underlying Tamala Limestone in the vicinity of Sunday Island Bay (including Lot 304) are part of the Carrarang Sand system which also extends over much of the Edel Land Peninsula on the mainland south of Dirk Hartog Island.

The Carrarang Sand typically consists of pale red and yellow to white medium grained, weakly lithified calcareous sands, made up of fragments of molluscs and foraminifers, and containing varying amounts of quartz sand. It forms into various types of dunes including parabolic dunes (long and scoop shaped) that are common on Dirk Hartog Island.

3.2 Land Systems

A land system is 'an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation'.

An inventory and condition survey of rangelands in the Carnarvon Basin by the then Department of Agriculture* (Payne et al 1978) provides mapping of land systems at a publication scale of 1:250,000. This broad-scale mapping includes Dirk Hartog Island and shows Lot 304 as part of the Edel system.

The Edel land system is described as '*Undulating sandy plains with occasional dunes, limestone rises and saline flats; low acacia shrublands with some saltbush and heath communities.'*

With the benefit of site-specific observation and more detailed aerial photography, Lot 304 and adjacent land immediately north and south, is more correctly identified here as part of the Coast land system.

The Coast land system is described by Payne et al as '*Strongly developed coastal dunes with narrow swales, limestone plains, wave-cut platforms and beaches, supporting diverse tall and low shrublands*.' In common with Edel, the Coast land system occurs extensively across Dirk Hartog Island.

3.3 Topography

Figures 2a and 2b overleaf show Lot 304 as an elongated strip of land parallel to, and starting approximately 75 m inland from, the coastal highwater mark. The dunal terrain is undulating with gentle gradients (less than 10%) on upland crests and within swales. Gradients on the dune side-slopes are predominantly moderate (10 – 15%) with only minor localised areas extending to 20 – 25%.

Topography - continued

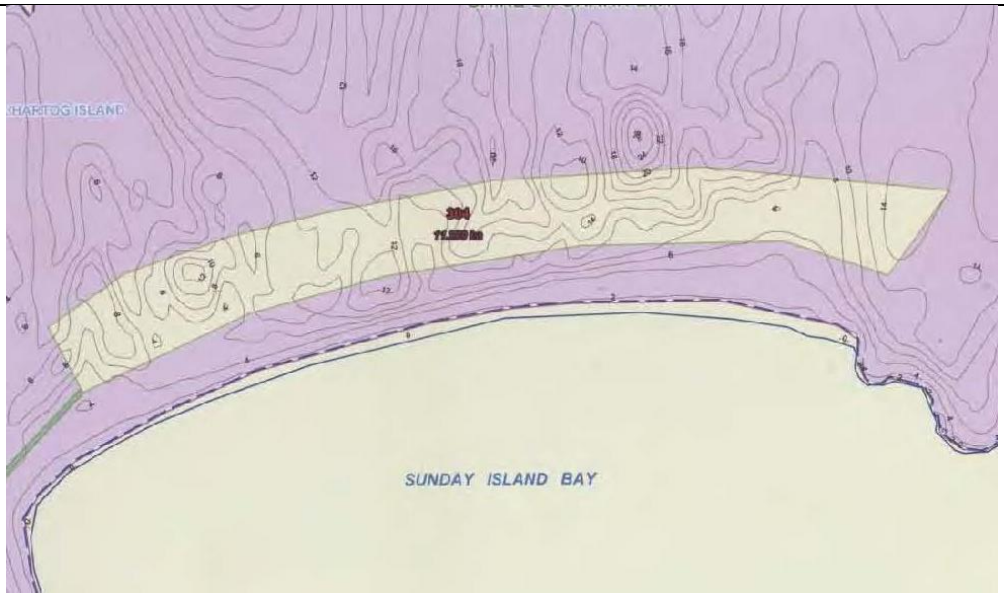
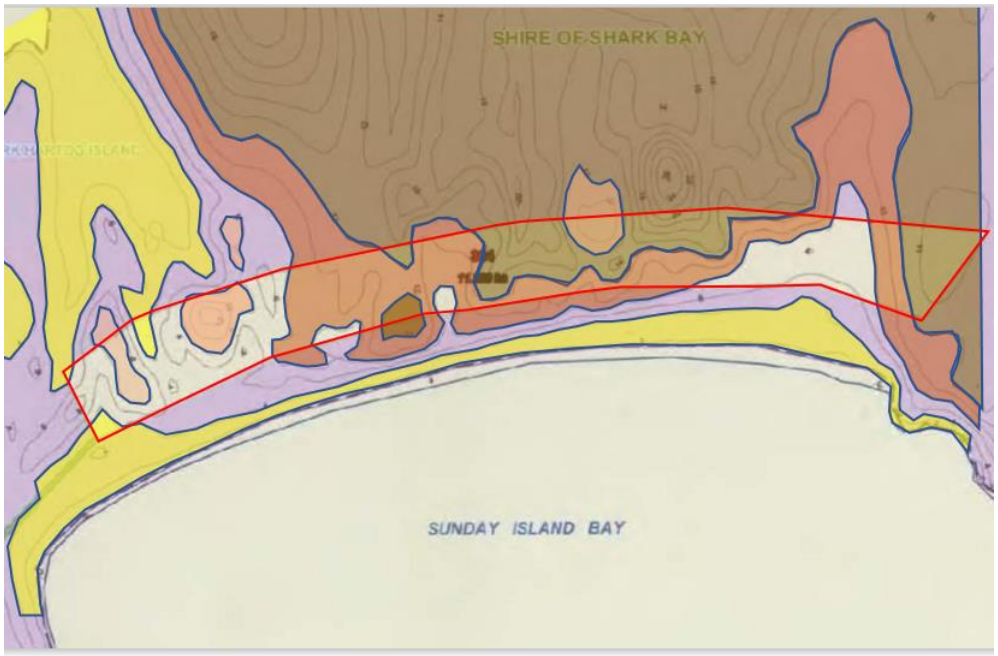


FIGURE 2A: TOPOGRAPHY (with 2 m contour intervals)



Topographic unit A: 12 m AHD and higher

Topographic unit B: 8 - 12 m AHD

Topographic unit C: 4 – 8 m AHD

Topographic unit D: less than 4 m AHD

FIGURE 2B: TOPOGRAPHIC UNITS (with colour-shaded elevation categories)

Topography - continued	Figure 2b delineates 'topographic units' based on elevation groupings. Detailed (0.5 m contour interval) survey and mapping of Lot 304 by surveyors Harley Dykstra (not included here) show the elevation ranges from a low point of 2.4 m AHD in the south western corner of the property, to a high point of 20.5 m AHD along the northern boundary at approximately two thirds of its extent towards the east.
3.4 Vegetation	In its report on the significance of flora within Lot 304 Ecosystem Solutions (2019) have aggregated site-specific data to describe the vegetation across Lot 304 as: '*Scattered shrubs of Acacia ligulata, over Open Heath in some areas of Diplolaeana grandiflora and Acacia ligulata, over Low Closed Heath of Thryptomene baeckeacea, Frankenia pauciflora, Acacia ligulata, Atriplex bunburyana and Atriplex vesicaria. Other common species included Sennecio pinnatifolius, Acanthocrapus preissii and Spinifex longifolius as well as numerous Poaceae weed species (Introduced Grasses)*'.
3.5 Hydrology and Marine Setback	There are no watercourses or wetlands within Lot 304, and it is not within a Public Drinking Water Supply Area (PWDSA). Given only about 200 mm rainfall per annum (and annual pan evaporation rates > 10 times this), and the mantling of sand dunes over all parts of Lot 304, it is internally draining with no surface runoff. The southern boundary of Lot 304 is shown on Figure 3 along with the approximate position of setbacks from the marine high water mark (100 m for conventional septics and 30 m for ATUs.
3.6 Groundwater	There are no existing bores or wells within Lot 304 or in close proximity. The *Sunday Island Bay Environmental Report* (Hypermarket Pty Ltd 2014) provides anecdotal evidence that '*based on the depth of existing wells on the east coast of Dirk Hartog Island the groundwater is between 10 m and 25 m below the proposed building and infrastructure sites* (within Lot 304)'. Based on the topography (land rising away from the coast, and the geology (dunes underlain by Tamala Limestone) it is reasonable to expect that downward percolating rainwater (or effluent) within the dunes might travel towards the marine environment if it were not intercepted by plant roots and lost to vegetative evapotranspiration within the intervening foreshore terrain. Given the location of Lot 304 in close proximity to the Shark Bay Marine Park and its presence within a World Heritage Area, it is a designated 'sewage sensitive area' (State Government of Western Australia 2019 and www.espatial.dplh.wa.gov.au) and in this locality includes '*land that drains to and is within 2 km of … Shark Bay'*.
3.7 Required Conditions	Lot 304 is within a designated 'sewage sensitive area' and the general site conditions required here for on-site sewage management systems under the GSP and existing Health Regulations, are summarized in Table 1.

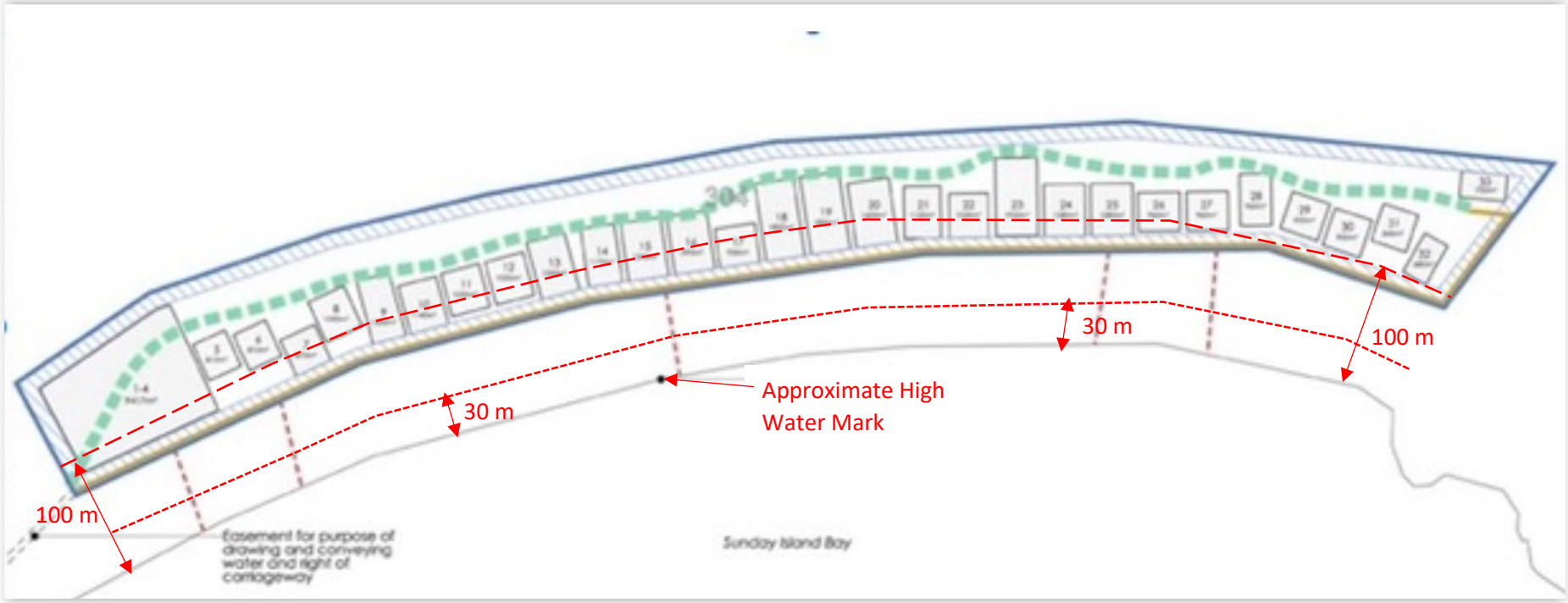


FIGURE 3: LOT 304 AND BUILDING ENVELOPE LAYOUT RELATIVE TO HIGH WATER MARK

Note: The 100 m setback shown here applies to the positioning of primary treatment systems (septic tanks and leach drains) from the marine environment. A lesser setback of 30 m, also shown, applies to secondary treatment systems (aerobic treatment units).

Source: Adapted from Figure 1 of *Coastal Risk Management Lot 304 Sunday Island Bay, Dirk Hartog Island* (Damara WA Pty Ltd 2019) - letter report to Mr Geoff Wardle 19 Dec 2019. Company Ref 281.02.

Table 1: General Site Requirements for On-Site Sewage Disposal

Site Feature	Minimum Requirement in Sewage Sensitive Areas
Separation from groundwater	The discharge point of the on-site sewage system (land application area) should be at least 1.5 metres above the highest groundwater level.
Site drainage	Land is not to be subject to inundation or flooding at probability greater than once in 10 years
Setback from marine environment	The GSP does not specifically address setbacks from the marine environment although it requires 100 m from any 'significant wetland'. The policy enables smaller setbacks to be considered where a proponent is able to demonstrate to responsible authorities (in this case the Department of Biodiversity, Conservation and Attractions), that reduced setbacks will not have a significant impact on the (marine) environment. The GSP also states that *in seeking a reduced setback, it is likely that secondary treatment systems with nutrient removal will be required.* The Draft Country Sewerage Policy (released in 2002, amended 2003), although superseded by the GSP, specifically addressed the marine setback as follows;. <u>Conventional septic systems (primary treatment)</u> : • 100 m where soil type has a phosphorous retention index (PRI) < 5, and 30 m if soil type has a PRI > 5. <u>Alternative Systems (secondary treatment) with ability to remove phosphate</u>: • 30 m regardless of soil type / PRI <u>Note</u>: In addressing proximity to the marine environment, it is assumed here that DBCA advice in relation to setback distances for on-site effluent disposal would be consistent with that in the former Draft Country sewerage policy above.
Setback from watercourses	100 m from a waterway.
Setback from bores used for drinking water purposes.	"Effluent or liquid wastes will not be discharged into the ground at a distance less than 30 m from any well, stream or underground source of water intended for consumption by humans" (Health Regulations - No 49).
Land application area and maintenance.	Each lot (building envelope in this case) to be of sufficient size to accommodate development and an unencumbered land application area determined in accordance with Schedule 2 of the policy (requires consideration of soil category, and hydraulic load). The land application area should be kept free of any temporary or permanent structures. It should not be built on or paved in a manner which precludes reasonable access, and not be subject to vehicular traffic or regular foot traffic.
Gradient	Where slope exceeds one in five (1:5 or 20%), the land application area should be engineered to prevent run-off.
Setback from buildings etc.	1.8 m from buildings, boundaries, and treatment apparatus.
Lot sizes	A minimum 1 ha, although 'case by case assessment' for strata lot for an approved grouped dwelling or commercial development, owned and operated by a single person or entity.
Type of treatment system	Secondary treatment systems with nutrient removal will generally be required in sewage sensitive areas. In remote areas, the availability of maintenance personnel is to be considered.

4.0 EVALUATION OF LOT 304 AND ITS SOILS

4.1 Determining Land Conditions

Nineteen soil observation sites were strategically located within, or in vicinity of Lot 304 after consideration of;

- the range in topographic units within Lot 304 (Figure 2b),
- the planned position of the eight (initial stage) accommodation units,
- the nature of terrain adjacent to Lot 304, and
- the nature of intervening terrain between Lot 304 and the beach.

The locations of soil observation sites are shown in Figure 4 along with the rationale for their positioning.

At the majority of sites (sand dunes within Lot 304) a shallow pit was excavated to approximately 50 cm depth using a shovel. Observation (and strategic sampling) of subsoil at greater depth was achieved using a fluted depth probe sledge-hammered in to approximately 150 cm depth.

Observation and sampling of soils to any depth greater than 150 cm was not possible in the absence of a backhoe (or similar machinery) and extraction by hand auger being thwarted by the very dry, loose consistency of the sands.

Given the nature of the dune terrain and its likely elevation above any buried limestone, samples at 150 cm depth were considered sufficiently representative of the subsoil environment into which any on-site disposal of either primary or secondary treated wastewater / effluent would occur.

The uniformly dry sandy soils were described in-situ in terms of landform position, soil texture, colour, depth and calcareousness, with samples taken for subsequent determination of pH and salinity (Electrical Conductivity) using a Eutech PCTestr 35 combined pH and conductivity meter.

Ten subsoil samples, considered representative of the range of receiving environments (topographic units) for land application of either primary or secondary treated wastewater / effluent within Lot 304 were delivered to the CSBP Soil and Plant Analysis Laboratory in Perth for determination of soil phosphorus retention ability (PRI) as well as additional pH and salinity (EC) measurements.

The soils were classified in accordance with the ‘Soil Group’ nomenclature (Schoknecht and Pathan 2013) of the Department of Primary Industries and Regional Development (DPIRD). Indicative subsoil permeability for each site was assigned on the basis of soil texture within the nominal leach drain or subsoil irrigation depth (approx. 20 – 80 cm) as per Table L1 of the Australian Standards (AS 1547) relating to *On-site Domestic Wastewater Management* (refer Attachment C).

FIGURE 4: SITE LOCATIONS

Site 1: to the west of Lot 304 within markedly different terrain (shallow limestone, and typical of Edel rather than Coast land system). **Site 2**: within lowest area of Lot 304 (a lowland swale - topographic unit D). **Sites 3 - 4**: outside Lot 304 as part of a transect to the beach. **Sites 5 - 8,10 -13**: within nominated building envelopes for the eight (initial stage) accommodation units (topographic units B and C). **Site 9**: outside Lot 304 (an upland swale within topographic unit C). **Sites 14 -15**: outside Lot 304 as part of a transect to the beach. **Sites 16 -18**: within Lot 304 to encompass topographic units A, B and C. **Site 19**: outside Lot 304 within markedly different terrain (shallow limestone associated with coastal headland).

4.2 Results	Attachment D provides a collation of the site data (field and laboratory) and site photographs. Table 2 provides an interpreted summary for each of the four topographic units shown in Figure 2b. Groundwater, or evidence of any long term persistence of a perched water-table, was not encountered within any of the observed soil sites including site 2 at the lowest portion of Lot 304 (Topographic unit D). Within topographic units A, B and C the soils are consistently deep, rapidly drained, pale calcareous sands (with slightly darker variants within upland swales or depressions) within the elevated undulating parabolic dunes that are roughly aligned inland and perpendicular to the coast. Sampling and analysis of these soils show they most commonly have a moderate' PRI (phosphorus retention index) indicating a modest ability to filter and retain nutrients from effluent. Within topographic unit D the soil profile at site 2 (Attachment D photo 3) showed a typical calcareous sand for a swale (dunal depression) up to 60 cm depth, then a buried weathering layer (strong brown sand) over rock (presumed limestone). The buried rock / limestone layer within topographic unit D would impede downward percolation of any significant amounts of rainwater (or effluent). As this layer is considered likely to extend towards the coast (and possibly underlying the beach) it could provide a pathway for movement of pollutants towards the marine environment. Sands within the intervening dunes (foredunes and secondary dunes outside of Lot 304 and aligned parallel to the beach) have a very low PRI (i.e. limited ability to filter and retain nutrients).

TABLE 2: SUMMARY OF SOIL CONDITIONS FOR TOPOGRAPHIC UNITS

Topo Unit (elevation range)	Soil	Perm-eability	pH	Salinity	Soil PRI (no of samples)	Ground water (highest)
A (> 12 m AHD)	Calc deep sand	> 3 m/day	Moderately Alkaline	Non-saline	-	> 2 m depth
B (8-12 m)	Calc deep sand	> 3 m/day	Moderately to Strongly Alkaline	Slightly or Non-saline	Moderate (3) to Low (1)	> 2 m depth
C (4-8 m)	Calc deep sand	> 3 m/day	Moderately Alkaline	Slightly or Non-saline	Moderate (1)	> 2 m depth
D (< 4m)	Calc shallow sand over l'stone	> 3 m/day until limestone.	Moderately to Strongly Alkaline	Moderate to Highly saline	Moderate (1)	Possibly perched at 80 cm depth for short periods.
Outside Lot 304 towards beach - 2^{o} dune	Calc deep sand	> 3 m/day	Moderately to Strongly Alkaline	Slightly or Non-saline	Very low (1)-	-
Outside Lot 304 towards beach – incipient 1^{o} dune.	Calc deep sand	> 3 m/day until saturated zone or limestone	Moderately Alkaline	Variable - Highly saline to non-saline	Very low (2)	-

4.3 Land Capability Assessment

Due to the relative consistency of the soils, the topographic units shown in Figure 2b provide an appropriate geomorphic framework for land capability assessment across Lot 304, and it is unnecessary to conduct a specific site and soil assessment at each and every proposed building envelope.

'Land capability' is a term referring to the ability of land to support a proposed change in use with minimal risk of degradation to soil and water resources. A general method for land capability assessment is described by van Gool et al (2005), and Wells and King (1989). It involves a five class system (from very high to very low capability) to express the degree of fit between land use requirements and the inherent environmental conditions of the subject land.

For Lot 304 the proposed use being assessed is 'on-site sewage disposal' and the general requirements in a 'sewage sensitive area' are outlined in Table 1. Considering these requirements against the conditions within each of the four topographic units (Table 2) results in Figure 5.

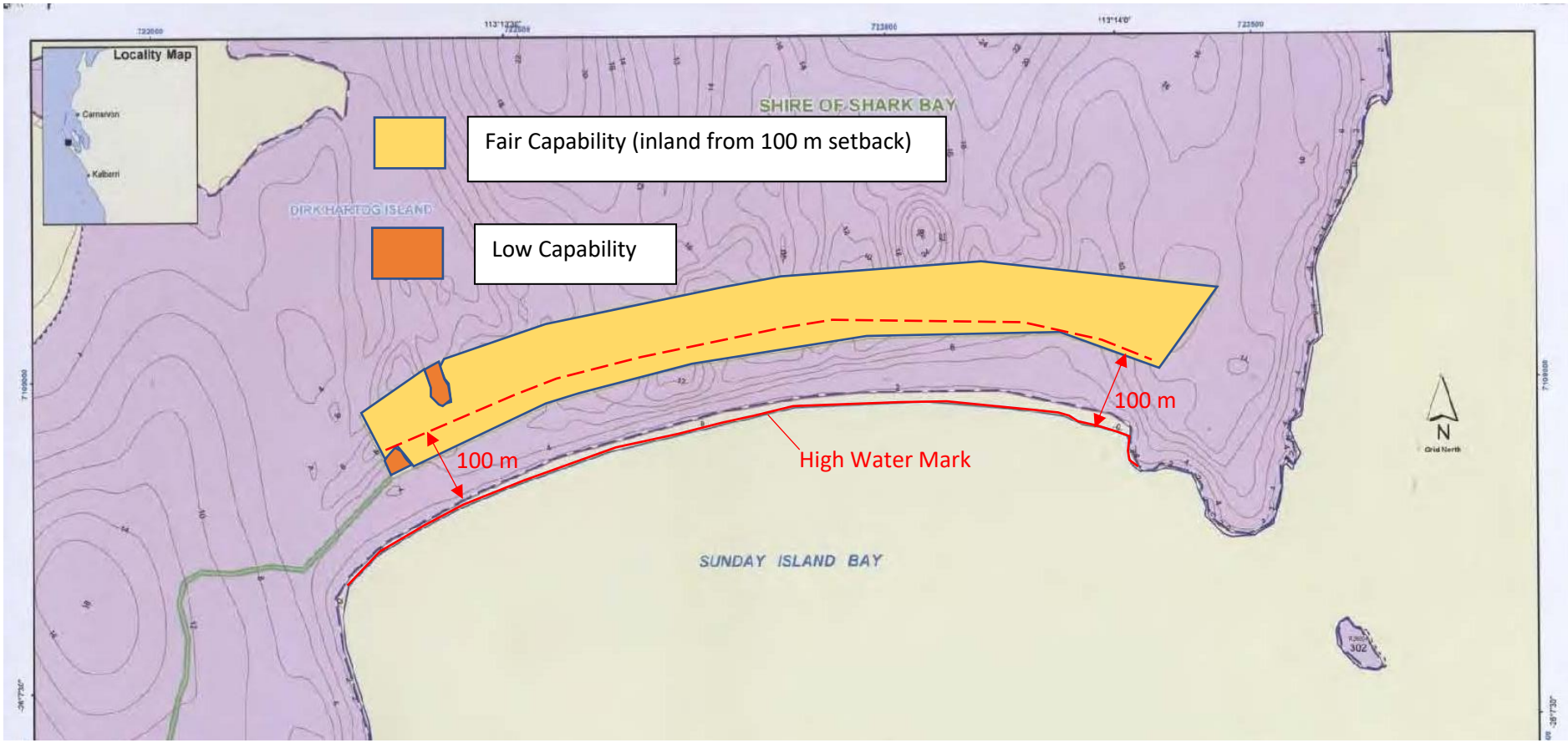


FIGURE 5: LAND CAPABILITY FOR ON-SITE EFFLUENT DISPOSAL

4.3 Land Capability Assessment - continued

The capability assessment results in Figure 5 are further outlined as follows;

Topographic Units A, B and C

1. These areas have an inherently 'Fair' (class 3) capability to support on-site sewage disposal.

2. They are subject to moderate limitations relating to the modest ability of the rapidly drained sandy soils to retain nutrients and to purify effluent of microbial contaminants.

3. In terms of mitigating any risk to public health or the environment, these limitations could be addressed by;

- Ensuring any land application areas (e.g. leach drains) for effluent arising from any primary treatment systems (septic tanks) are located at a distance of greater than 100 m from the marine environment (high water mark – see Figures 3 and 5), or

- Using Health Department approved secondary treatment systems (previously known as Aerobic Treatment Units, ATUs, - some with nutrient removal capability) are used for all accommodation units.

Topographic Unit D

1. These areas have an inherently 'Low' (class 4) capability to support on-site sewage disposal.

2. They are subject to significant limitations relating to the presence of an underlying rock/ limestone layer at less than a meter depth. This has the potential (under conditions of a very high rainfall event, or a high hydraulic effluent loading) to cause subsoil waterlogging and a possible horizontal transport pathway for nutrients and other effluent contaminants to reach the marine environment.

3. In terms of mitigating any risk to public health or the environment, this limitation could be addressed by;

- avoiding these lowest-lying areas for any form of effluent disposal

4. The mitigation measure would be easily achieved given the small extent of topographic unit D relative to the proposed 9,417 m^2 size of the building envelope it is encompassed by (see Local Development Plan – Attachment A).

5.0 OTHER CONSIDERATIONS

5.1 Treatment and Disposal Options

The proponent has identified conventional septic tank and leach drains (primary treatment systems) as a preferred option for sewage management at each of the 33 proposed accommodation units, with secondary treatment systems (ATUs) as a second preference. All systems for use in Western Australia require the approval of the Department of Health. A list of approved systems is available online at https:/ww2.health.wa.gov.au.

Primary Treatment Systems (Septic Tanks)

- Septic tanks are waterproof tanks used for primary treatment of sewage / wastewater by settling and anaerobic bacterial digestion.
- Septic tanks do not remove nutrients and the wastewater is not disinfected.
- Under the relevant regulations (Supplement to No 29 – Department of Health 2015) the size of septic tanks for non-residential applications needs to be calculated on the basis of 1,360 litres (for a blackwater system) plus an allowance for the total wastewater volume (i.e. number of persons multiplied by the estimated daily flow per person).
- Following primary treatment in a septic tank, the resulting liquid effluent is usually disposed of by land application (below ground) using leach drains or soakage wells.
- Leach drain trenches need to be excavated so that the floor has a very shallow gradient to ensure an even spread of effluent along its length and away from the entry point.
- Septic tank and leach drain systems generally require low maintenance and no power source. Effluent is of poor quality however and therefore there is potential for groundwater contamination.

Secondary Treatment Systems (Aerobic Treatment Units)

- ATUs are electrically driven units involving aeration as an integral part of the treatment process followed by clarification to achieve secondary treatment of sewage / wastewater.

- Various systems are commercially available and can include disinfection of wastewater (required when any surface irrigation is proposed).

- The wastewater (liquid) from the ATU is directed to an irrigation area (surface or subsurface) but can also be directed to leach drains. (Note: The latter is considered desirable within Lot 304 due to lower maintenance input and ease of installation).

- ATUs typically produce effluent of a higher quality than that produced by septic tanks, with lower BOD, lower suspended solid levels, and much lower faecal coliform levels. Some ATUs are also approved for Phosphorus removal.

- ATUs must be serviced by an authorised service person on a regular basis (usually quarterly) as per the conditions of product approval issued by the Department of Health.

- If ATUs are to be used the proponent favours using a FujiClean wastewater treatment system. This manufacturer's CE1500EX model is currently listed as a WA Health Department approved system.

- Attachment E contains a brochure for the CE1500EX model which includes statements on nutrient removal capacity (54% Nitrogen reduction and 87% Phosphorus reduction) as well as data indicating the treated effluent meets standards required in relation to Biological Oxygen Demand (BOD) Suspended solids (SS) and E coli levels.

Dry Composting Toilets

- Dry (waterless) composting toilets collect urine and faeces in a sealed chamber beneath the toilet pedestal, where microorganisms decompose the mixture of human waste and extra organic matter (e.g. kitchen scraps). About three-quarters of the material is converted into carbon dioxide and water vapour.

- The remaining compost moves slowly down a sloping floor by gravity as more material is added to the pile. It then moves under a dividing baffle into a humus chamber. After a period of time, that varies with usage, this material is suitable to remove. Excess liquids drain to a small absorption trench and may be treated with greywater.

	- Dry composting toilets collect and treat only toilet waste (blackwater) to a primary standard (a similar standard as septic tanks). Greywater from the bathroom and laundry needs to be treated separately. - Dry composting toilets do not require a water supply for their operation. Regular maintenance is needed however as the water content of the compost heap is critical for efficient and odourless operation. - Given their maintenance requirements, it is anticipated that dry composting toilets might only be considered for the accommodation units within Lot 304 in the event that water supplies are limited. <u>Government Agency Advice</u> In advice given to the Shire of Shark Bay in relation to an earlier proposal for 'short stay units' within Lot 304 Sunday Island Bay, the Environmental Protection Authority (EPA) stated; '*While the EPA notes that a septic system is currently in use at the Dirk Hartog Island Lodge, the use of such systems does not comply with the EPA's principles of best practice and continuous improvement as identified in Environmental Assessment Guideline 8. The EPA therefore does not support the installation of septic systems and instead recommends that Aerobic Treatment Units (or similar) are installed for on-site effluent disposal.'* Additionally, the Government Sewerage Policy indicates that it will be up to the Department of Biosecurity, Conservation and Attractions (in consultation with the Shire of Shark Bay) to advise on sewage management options (i.e. primary or secondary systems, with or without nutrient removal capability) as well as marine setback requirements. The latter is in the context of protecting the environmental values associated with the land's designation as part of a 'sewage sensitive area' and a World Heritage Area.
5.2 Calculating Land Application Areas	The land application area is the designated area of land within a building envelope where the effluent from a treatment system (primary or secondary) is applied into or onto the ground. Land-application systems fall into two broad categories; • Soil absorption systems (e.g. leach drains – or absorption trenches or mounds as referred to in AS 1547). • Irrigation systems (e.g. covered surface drip irrigation, shallow subsurface irrigation, or above ground spray irrigation). Leach drains are considered preferable within Lot 304 due to lower maintenance input and ease of installation.

Determining an indicative size of the land application areas for accommodation units is necessary to demonstrate the ability of proposed building envelopes to physically accommodate systems for on-site sewage management.

The Local Development Plan (Taylor Burrell Barnett 2020) shows building envelopes ranging in size from 700 m^2 (BE 33) to 9,417 m^2 (combined BE 1-4). Preliminary designs for the initial 8 accommodation units show building footprints of less than 300 m^2. For the smallest building envelope, this leaves up to 400 m^2 available for the land application area.

Method to Determine an Indicative Size of Land Application Areas

Two methods are available to determine an indicative size of the land application area;

- Regulation 49 of the Health Regulations (Gov't Printer 2005), or
- Schedule 2 of the Government Sewerage Policy (Gov't of WA 2019)

Both methods use an estimated hydraulic load with consideration of a loading infiltration rate based on soil type and the type of on-site treatment system to determine a minimum infiltration area.

Where the methods differ however is primarily in how this minimum infiltration area is translated into the length of leach drains (and subsequently the land application area) required to provide that minimum infiltration area as follows;

- *Using Health Regulations* – the various Health Department approved leach drains (Attachment F) have a listed infiltrative area per linear meter of drain which recognizes that they have permeable bases (width) and walls (height) that enable both downward and lateral movement of effluent into the surrounding soil. Furthermore, for primary treatment systems within sands, a loading infiltration rate of 30 mm/day is specified.
- *Using Schedule 2 (GSP)* – only downward movement of effluent into the surrounding soil is taken into consideration with just the base (width) of leach drains used to determine the required length of leach drains (and subsequently the land application area). Furthermore, for primary treatment systems within sands, a lower loading infiltration rate of 20 mm/day is specified.

Schedule 2 of the Government Sewerage Policy is based on a very conservative approach to risk management for on-site effluent disposal. Whereas calculations based on existing Health Regulations show that an unencumbered area of up to 150 m^2 is generally required to accommodate a land application area for primary treated effluent using leach drains within sands, the method used in Schedule 2 of the GSP (Attachment G) results in a land application area of 339 m^2 for the same system and soil environment.

Given the magnitude of this discrepancy and the likelihood that the designers and installers of any specific sewage management system within Lot 304 on Dirk Hartog Island will be more familiar with, and hence use, the existing Health Regulations to determine land application areas, then same method is used here to provide an indicative size of the LAA to be accommodated within each building envelope as follows;

Minimum infiltration area

Under Regulation 49 of the Health Regulations (1974) minimum infiltration area is determined in accordance with the following formula;

A = V/ L.I.R.

where;

A = minimum infiltration area (m^2).

V = volume of wastewater (litres), which is now determined from the *Supplement to Regulation 29 and Schedule 9* DoH 2015 (Attachment B) which, for non-residential premises lists 'large short-stay holiday houses (> 6 persons) / Eco-tourism accommodation facilities as 140 L/person/day.

Based on the conservative principle that that sewage management systems should be of sufficient capacity to treat the peak wastewater / effluent flow generated by the facility being served, the maximum volume of wastewater for each accommodation unit is 1120L/day (see earlier Section 1.5 of this report).

L.I.R. = loading infiltration rate, is determined in accordance with Schedule 8 of the Regulations, which (for primary treatment systems) specifies 30 L/m^2 /day (i.e. 30 mm/day) for alternating leach drains systems within sands.

The minimum infiltration area **A = 37.3 m^2** (1120/30)

Required length of leach drains

The required length of leach drain required to provide this minimum infiltration area is determined by dividing that area by the infiltrative area per linear meter of leach drain* As shown in Attachment F the infiltrative area varies between the products that have been approved by the Department of Health. By way of an example to use here, the DoH approved Atlantis plastic leach drains come in 0.685 m long modules with an infiltrative area of 1.3 m^2/m.

The **required leach drain length = 28.7 m** (37.3 /1.3)

*Leach drains have permeable bases and walls enabling both downward and lateral movement of effluent into the surrounding soil.

Land Application Area to accommodate the leach drains

For leach drains (associated with primary treatment systems and usually configured in equal length pairs), the land application area can be determined after consideration of the length of the drain modules, required separation distances between parallel drains, and the required setback distances from buildings or building envelope boundaries.

For the purpose of this calculation of an indicative land application area using Atlantis plastic leach drains the 28.7 m can be achieved using 42 modules (of 0.685 m each) or two parallel drains of 21 modules each and approx. 14.4 m long.

A 3 m spacing between drains is used here and, under the Health regulations, a minimum setback of 1.8 m is required away from building areas, the building envelope boundary and the treatment apparatus (septic tank).

The area required to accommodate the leach drains is therefore based on;

- Length = 2 plastic drains of 14.4 m plus 1.8 m setbacks at each end = 18 m
- Width = 2 drain base widths (0.4 m each) plus separation of 3 m plus 1.8 m setbacks at each side = 7.4 m

For primary treatment systems

For septic tanks using leach drains in sands of Lot 304 the Land Application Area for each accommodation unit is therefore;

LAA = 133.2 m^2 (18 m length X 7.4 m width)

Or, using a more conservative loading infiltration rate of 20 mm/day for sands (as suggested by Australian Standards AS 1547 (Attachment C) and the Government Sewerage Policy), each accommodation unit would require four (shorter) leach drains with the Land Application Area being;

LAA = 207.3 m^2 (14.6 m length X 14.2 m width)

For secondary treatment systems

For Aerobic Treatment Units (ATUs) using leach drains in sands of Lot 304 the Land Application Area for each accommodation unit is determined using a loading infiltration rate of 50 mm/day (refer to Attachment C).

Using the same method to calculate LAAs outlined above, each accommodation unit would require two leach drains with the Land Application Area being; **LAA = 92.5 m^2** (12.5 m length X 7.4 m width)

	Ability of Building Envelopes to Accommodate LAAs Given the smallest proposed building envelope has up to 400 m^2 available for the land application area, and the required areas range from 92.5 m^2 to 207.3 m^2 (depending on type of system and loading infiltration rate used), all building envelopes will be of sufficient size to allow for on-site treatment of sewage and disposal of effluent.
5.3 Cumulative Impacts	The potential cumulative impact of onsite effluent disposal to the waters of the marine reserve cannot be easily quantified here. This is because the existing pre-development hydraulic load ultimately reaching the local marine environment (if any, given the low rainfall and high evaporation) as a result of rainfall affecting Lot 304 is unknown. It is speculated that the underlying limestone layer encountered at site 2 within the lowest portion of Lot 304 could be part of a more extensive rock platform beneath the dunes and act as a 'perched groundwater' pathway for the flow of effluent towards the marine environment after it has percolated downward through the overlying dunes. However, this has not been rigorously established. The marine area is <u>likely</u> to be down-gradient hydrologically from the location of any effluent (treated to either primary or secondary level) after it has percolated downwards through the sandy soil and met an underlying limestone layer. The potential reductive effect on any underlying movement of effluent caused by evapotranspiration of plants within the strip of land (approx. 75 – 100 m wide) which separates Lot 304 from the marine environment, is also unknown and therefore prevents quantification of both the pre and post-development hydraulic loading impact. The post development cumulative hydraulic load is estimated to be approximately 14.64kL per day spread across the 11.295 ha area of Lot 304 (refer Section 1.5). Key factors influencing how much of this hydraulic load reaches the marine environment and the potential cumulative impact of the attendant nutrients and other pollutants, are; • The type of treatment system used • The setback distance from the marine environment, and • The density of development <u>Type of treatment system</u> As part of a Department of Water submission to the National Pollutant Inventory, Kelsey et al (2011) report that nitrogen and phosphorus emissions from primary treatment systems (septic tanks) are estimated to be 5.5 and 1.1 kg/person /year on the basis of the research of Whelan and Barrow (1984a, 1984b) and Whelan et al (1981).

If secondary treatment systems are used a significant reduction in microbial contaminants can be expected as a result of the treatment and disinfection process. (i.e. accredited systems must produce effluent of secondary standard being 20 mg/L BOD, 30 mg/L of Total suspended solids, and 10 cfu/100 mL of E coli).

If secondary treatment systems incorporating nutrient removal capacity are used, an additional significant reduction can be expected in the environmental impact risk factor. The suggested secondary treatment system for use within Lot 304 (FujiClean CE-1500EX) is claimed by the manufacturer to achieve 54% nitrogen reduction and 87% phosphorus reduction (Attachment E).

Setback distance

Figure 3 shows the location of the proposed building envelopes within Lot 304 relative to the edge of the marine environment (high watermark).

A 100 m setback distance is depicted and this should be applied to the positioning of primary treatment systems (septic tanks and leach drains) from the marine environment. A lesser setback of 30 m applies to secondary treatment systems (aerobic treatment units).

In relation to cumulative impacts, the greater the setback distance between on-site disposal systems and the marine environment the better, since this provides a greater opportunity for vegetation within the intervening strip of land to reduce the hydraulic load* through evapotranspiration.

*assuming a significant flow gradient in this direction

Density of development

The proposed development of Lot 304 is for an eco-tourism facility comprising 33 accommodation units (Attachment A). In accordance with conditions applying to the Shire of Shark Bay Local Planning Scheme (Special Use Zone SU14) the land cannot be subdivided.

It is understood from the proponent's environmental report (Hypermarket Pty Ltd 2014) that each accommodation unit is proposed to operate independently but no subdivision is proposed.

For unsewered residential developments the Government Sewerage Policy (GSP) regards lot size as a critical risk factor for on-site sewage disposal with progressively smaller lot sizes increasing the nutrient and non-nutrient contaminant loads per unit area. Explanatory Notes accompanying the GSP (Government of Western Australia 2019,b) state;

'The policy sets a one hectare minimum lot size in sewage sensitive areas primarily to manage the cumulative impacts on the environment and water resources.' and

	'The minimum (1 ha) *lot size requirement in sewage sensitive areas are consistent with … State Planning Policy 2.1 (Peel Harvey coastal catchment) of a maximum of one sewage disposal unit per hectare for rural residential development'.* The proposal for Lot 304 is <u>not</u> a form of subdivision or residential development, however it will put in place 33 sewage disposal units over the 11.295 ha lot which is equivalent to approximately three sewage disposal units per hectare. The GSP (Government of Western Australia 2019,a) does not prescribe a minimum lot size for unsewered survey strata and strata lots for grouped dwellings, commercial or industrial development. The GSP considers that the risks associated with on-site sewage disposal systems for unsewered survey strata and strata lots can be effectively managed without prescribing a minimum lot size based on consideration of maximum hydraulic loads, identification of land application areas, and the applicant's ability to demonstrate the site is capable of accommodating on-site sewage disposal in accordance with the requirements contained in the policy. The GSP Explanatory Notes further state; *'The risks can be further reduced through ensuring on-site systems are owned and operated by a single person/entity to provide the service, and … maintenance programs acceptable to the local government should be in place, particularly where secondary treatment is proposed.'* and *'For non-residential, commercial or industrial planning proposals in sewage sensitive areas, lot size will be assessed on a case by case basis. This is because nutrient loads will vary according to the proposed use'* (and type of sewage treatment system).

6.0 CONCLUSIONS

6.1 Capability of land to accommodate sewage disposal	The capability of Lot 304 in relation to on-site effluent disposal has been demonstrated by; • All proposed building envelopes being able to meet the Government Sewerage Policy's general site requirements for sewage sensitive areas as outlined here in Table 1 (subject to the use of secondary treatment systems and with the exception of a small, and easily avoided, portion of combined BE 1-4), and • Its 'Fair capability' rating for that use using the assessment system of the Department of Primary Industries and Regional Development (van Gool et al 2005). Furthermore, the ability of all building envelopes to physically accommodate sewage disposal systems has been demonstrated with the smallest envelope having up to 400 m^2 available after considering likely building footprint, and the required land application areas ranging from 92.5 m^2 to 207.3 m^2 (depending on type of system and loading infiltration rate used).
6.2 Proposed type of system	The use of a secondary treatment system with nutrient retention capability within all building envelopes would significantly reduce the risk of endangering public health or the environment. The FujiClean CE-1500EX advanced wastewater treatment system is an example which is approved for use in Western Australia and offers excellent nutrient removal ability.
6.3 Density of Development	The density of development is just under 3 sewage disposal units per hectare and the following mitigating factors should be considered; • The sewage disposal units are to service short-stay accommodation units. • The units are expected to be used only between February and October (0.6 of year) with up to 60% occupancy across Lot 304 at any one time. ((Hypermarket Pty Ltd 2014). • Controls can be placed on the development requiring use of secondary treatment systems, with maintenance of those systems collectively managed by a single person/ entity.

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ATTACHMENT A

LOCAL DEVELOPMENT PLAN

Source: Taylor Burrell Barnett – plan as at 18 May 2020

Local Development Plan Provisions

This Local Development Plan (LDP) has been prepared in accordance with Part 6 Schedule 2 of the Deemed Provisions of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

Lot 304 Sunday Island Bay is zoned Special Use No. 14 (SU14) under the Shire of Shark Bay Local Planning Scheme No. 4 and specific conditions apply to any future development. The objectives of the SU14 zone is to provide for ecotourism development. The LDP should be read with the relevant technical documents and management plans referred to in the LDP provisions.

The following provisions apply to guide development.

1 BUILDING ENVELOPES

1.1 Development shall be contained within the building envelopes as shown on the LDP, unless approved by the local government.

1.2 All ancillary development including water tanks, car parking, servicing infrastructure, outbuildings and effluent disposal systems are to be sited having regard for the following:

- Outbuildings are encouraged to be located so as to not obstruct the coastal aspect or views from habitable development and to minimise the visual impact as viewed from the ocean side of Lot 304;
- Soil suitability/capability for effluent disposal (refer LDP provision 7.1);
- Minimising removal of remnant vegetation;
- Bushfire management;
- Coastal hazard risks (refer to Coastal Risk Management Plan Notes); and
- Any other practical considerations such as topography.

1.3 The local government may require an updated flora report or vegetation information for any clearing outside of a building envelope.

1.4 Where there is a conflict between the number of envelopes shown on the LDP and any written LDP provision, the written provision shall prevail.

2 SITING AND SETBACK REQUIREMENTS

2.1 All buildings and structures shall be setback a minimum of:

(a) 11 metres from the Lot 304 cadastral boundaries in compliance with any Bushfire Management Plan and / or BAL assessment approved by the local government; or

(b) In accordance with the Asset Protection Zone setbacks to classified vegetation specified in any Bushfire Management Plan and / or BAL Assessment approved by the local government.

2.2 No building envelopes fall within the coastal erosion hazard setback line to 2070, as illustrated on the LDP, but will require coastal risk management (refer to Coastal Risk Management Plan Notes).

2.3 Buildings shall be setback a minimum of 2 metres from access routes.

3 BUSHFIRE MANAGEMENT

3.1 Proposed development shall demonstrate compliance with any Bushfire Management Plan and / or BAL Assessment approved by the local government.

3.2 The developer(s) / landowner(s) shall be responsible for the implementation and management of any Bushfire Management Plan and / or BAL Assessment approved by the local government so as to ensure that development is able to occur in the intended manner. All BAL ratings identified in the Bushfire Management Plan are indicative and are required to be verified at the time of construction of individual buildings to ensure appropriate setbacks identified have been achieved.

3.3 Vegetation (existing or proposed) and Asset Protection Zones in Lot 304 shall be managed and maintained as 'low threat vegetation' in accordance with any Bushfire Management Plan and / or BAL Assessment approved by the local government.

3.4 The strategic firebreak will allow people to access the periphery of Lot 304 and provide access to the foreshore.

4 BUILT FORM

4.1 Design Guidelines have been prepared and form part of this LDP. Development is to have regard to and address the Design Guidelines.

5 BUILDING HEIGHT

5.1 Inundation hazard is to be managed through avoidance, with minimum floor levels for habitable development to be not less than 4.2mAHD. Non-habitable development with finished floor levels less than 4.2mAHD may be considered by the local government for ancillary development that is detached from habitable development and can be easily relocated (refer to Coastal Risk Management Plan Notes).

5.2 New buildings and outbuildings to be low scale consistent with the Scheme. The local government may require a Visual Impact Assessment in accordance with condition 11 of the SU14 zone.

5.3 Buildings raised more than 1.0m above the minimum floor level, and/or buildings proposec as two-storeys may be approved by the local government where it can be demonstrated that the bulk and scale of the building takes into account topography, natural landscape and coastal amenity of the location.

6 VEGETATION AND LANDSCAPING

6.1 No introduced non-native species shall be planted on the lot. Revegetation shall not occur in conflict with the recommendations of any Bushfire Management Plan approved by the local government. The landowner(s) shall be guided by the Dirk Hartog Biosecurity Implementation Plan 2015.

7 SERVICE INFRASTRUCTURE

7.1 Development application(s) to provide details of effluent disposal in accordance with the Government Sewerage Policy 2019 and having regard to the Site and Soil Assessment Evaluation for Lot 304 Sunday Island Bay.

7.2 Development application(s) shall demonstrate servicing of building envelopes and development thereon with water supply (potable and firefighting 10,000L tanks) and electricity (including generation), to the satisfaction of the local government.

8 MANAGEMENT

8.1 Temporary sea containers and structures associated with construction may be in place for a maximum period of 12-months, or longer period approved by the local government, and thereafter removed from the island at the developer(s) / landowner(s) cost.

8.2 A management plan has been prepared and forms part of this LDP.

9 ADVICE NOTES

a. Regarding section 1 building envelopes, Lot 304 is subject to covenants to the benefit of the Minister of Lands and should be referred to by proponents. In particular the covenants provide details in relation to (amongst other things):

- The number of "visitor accommodation units" that may be built or placed on the land, and the floor area of each "visitor accommodation unit"; and
- The "staff accommodation" and the ratio of staff-to-guests and floor area per staff personnel being housed.

b. Regarding section 1 building envelopes, the number of building envelopes shown on the LDP is nominal and not all of the building envelopes may be able to be built on. The number of building envelopes depicted on this LDP may be amended, subject to approval by the local government.

c. Regarding section 3 Bushfire Management, Lot 304 is in a designated bushfire prone area. Landowners will educate and inform all guests of the increased risks associated with bushfire when staying on a remote tourism/ holiday accommodation development.

Location Plan

Legend

- Lot 304
- Building Envelope
- Easement
- Access Track (notional 6m wide)
- 11m setback to cadastral boundary (fire)
- Strategic Firebreak
- Coastal Access Point - indicative connections for construction. Pedestrian access having regard to recommendations in Damara WA 2019 and approval by DBCA.
- +2mAHD contour
- +4mAHD contour
- Coastal Erosion Hazard Setback to 2070 (Schedule One SPP2.6)

Coastal Risk Management Plan

1. Inundation risk is managed through avoidance, with all buildings on land >+4.2mAHD.
2. Erosion risk management is focused on beach access and dune management, with a longer-term consideration of managed retreat. Erosion risk management should follow the monitoring and management outlined in the revised Coastal Risk Management Plan (CRMP) (Damara 2019).
3. Beach access and dune management: Triggers for management action when there is >50m existing buffer to buildings include:
   (a) scarps >0.5m vertically in the beach access paths;
   (b) foredune scarping sustained with <5m of dune retreat;
   (c) dune deflation identified;
   (d) blowout formation;
   (e) additional beach tracks formed.

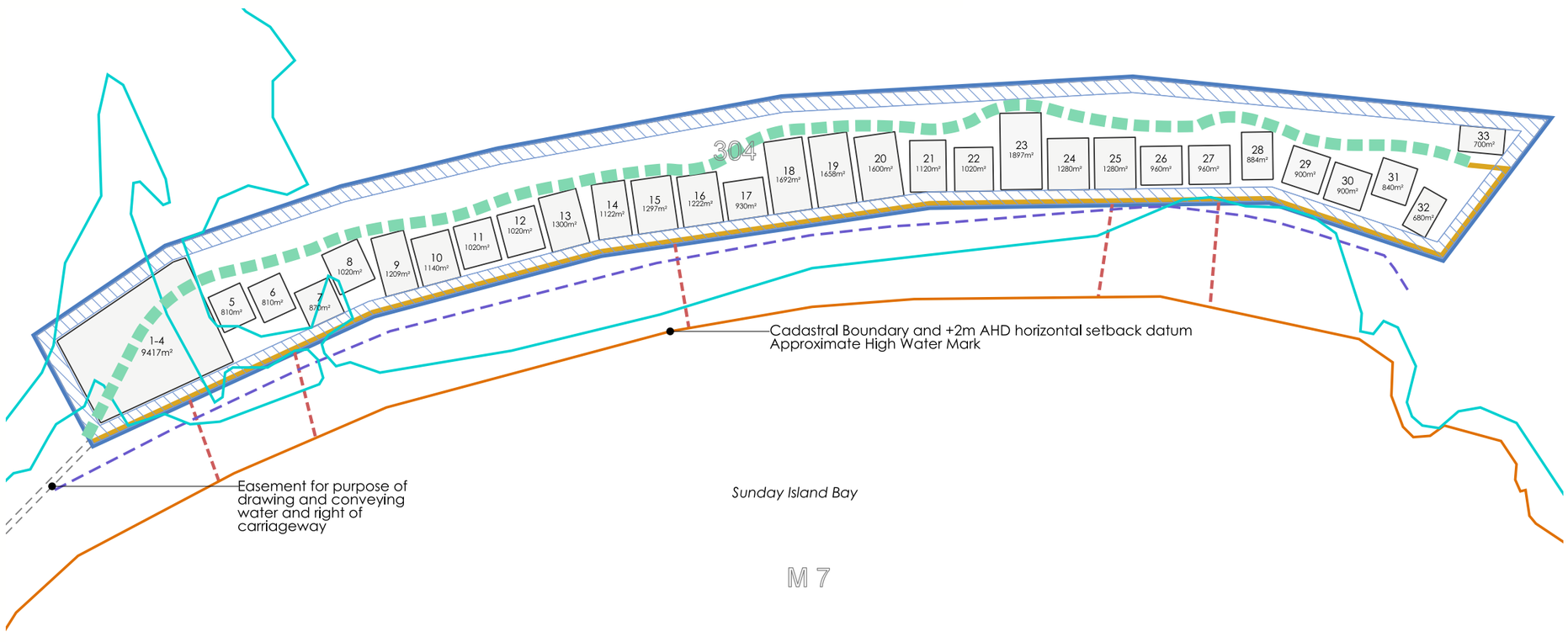
   Relevant management actions should be undertaken as outlined in Table 2 of CRMP including additional triggers for when 40-50m buffer remains.
4. Managed retreat: strategy of planned retreat should follow Section 1b of CRMP. A detailed management retreat plan will be submitted to the local government within six (6) months of the trigger of 40m remaining buffer between the +2mAHD contour, and buildings. Managed retreat may be planned for small groups of buildings while others are maintained with a >40m buffer. Retreat should be undertaken when remaining buffer is 30m. Each co-owner of Lot 304 will be responsible for building removal, rehabilitation and revegetation of the site where buildings are relocated. Any land rehabilitated following managed retreat shall not conflict with a Bushfire Management Plan and will not be ceded to the local government, and will require ongoing management.

Endorsement Table

This Local Development Plan has been approved by the Shire of Shark Bay Council at it's Ordinary Meeting held on the _____in accordance with Clause 52(1) of the *Planning and Development (Local Planning Schemes) Regulations 2015.*

Chief Executive Officer: _____

Date: _____



LOCAL DEVELOPMENT PLAN

Lot 304 Sunday Island Bay, Dirk Hartog Island

A DHI Developments Pty Ltd Project

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d: 18 May 2020
p: 19/061/003M

Taylor Burrell Barnett Town Planning and Design
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ATTACHMENT B

WASTEWATER SYSTEM LOADING RATES

Source: Department of Health (2015) *Supplement to Regulation 29 and Schedule 9 – Wastewater system loading rates,* November 2015.

Government of Western Australia
Department of Health

Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates

This factsheet is designed to be read in conjunction with Regulation 29 and Schedule 9 of the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 (Regulations)*.

This supplement does not cover every possible application and system designers are asked to contact the Water Team of the Environmental Health Directorate
for further information if a particular use premises type is not listed in this factsheet.

The following table forms the Department of Health WA's assessment criteria for systems assessed under the Regulations.

Residential premises

The sizing of residential premises hydraulic loading is based on Schedule 9 of the Regulations. For residential premises with 6 or more bedrooms, the hydraulic loading will be sized basing on the expected occupancy rate and the design flow rate of 150L/person/day.

Table 1: Hydraulic loading rates for residential premises

Type of residential premises	Number of bedrooms	Volume of wastewater (L/day)
Standard residential dwelling	2 or less	564
	3	761
	4-5	829
	6 or more	150L/day Local government to determine the expected occupancy rate.
Ancillary accommodation sharing a common system with the main residential dwelling	The combined hydraulic loading is based on the ***total combined number of bedrooms*** (ancillary dwelling PLUS main residential dwelling) and sized as a "Standard residential dwelling" (as above). Example: • 3 bedroom main dwelling ***PLUS*** 2 bedroom ancillary accommodation = 5 bedroom system (829L/day) • 4 bedroom main dwelling ***PLUS*** 2 bedroom ancillary accommodation = 6 bedroom system (150L/person/day)	
Aged home accommodation	2 or less	564
	3	761
	4-5	829
	Developments with communal system	Hydraulic calculation basing on actual occupancies can be permitted if local government planning approval sets occupancy limits for the entire development. 150L/person/day

Please note that the sizing of septic tanks must still be done in accordance with Regulation 28 of the Regulations and the sizing method is different from what is prescribed in Table 1.

Non-residential premises

The wastewater system loading rates prescribed in Regulation 29 are limited to a number of broad applications. The purpose of this fact sheet is to provide designers of wastewater and associated disposal systems with a more comprehensive list of equivalent premises and uses. The figures below are to be read in conjunction with Regulation 29(1) and are based on an 8 hour day.

Table 2: Human waste hydraulic loading rates

Type of premises (Regulation 29)	Equivalent Use	Combined Flow (L/person/day)
Hotel	Minesite accomodation camp units	180
Motel		140
School (boarding)		140
School (day)	Child care centre (6 hours contact time)	45
Public Building (Frequent use)	Bakery sit in customers (per sitting) Café sit in customers (per sitting) Place of worship (with cooking and catering facilities) Health centre staff (non-showering) Minesite office facilities Offices (non-showering staff) Restaurants sit in customers (per sitting) Winery sit in customers – Café and food catering facilities (per sitting)	30
Public Building (Infrequent use)	Airport (Non-staff) Place of worship (with no cooking facilities) Community hall Hardware stores Health centre patients (non-showering) Library Petrol station customers	10
Caravan Parks	3 persons / caravan park bay	140
	2 persons / tent site	140
	Park homes / chalets / Standard short-stay holiday houses 2 or less bedrooms/dwelling 3 bedrooms/dwelling 4 or more bedrooms/dwelling	 564/dwelling 761/dwelling 829/dwelling
	Large short-stay holiday houses (>6 persons) / Eco-tourism accommodation facilities	140
Swimming Pool		15
Drive-in theatres	2 persons per car	10
Factories & shops (an 8 hour day)	Bakery Staff Café staff Caravan park staff member (not living onsite Gym (with showers) Health centre patients (using shower facilities) Office staff (using shower facilities) Restaurant staff Warehouse staff Workshop staff	70
Construction camps (temporary)		45
Clubs	Men's shed	15

Clubs (licensed)		35

There are other types of wastewater generating activities that are not specified by Regulation 29. Under these circumstances the following will apply:

Table 3: Commercial / industrial waste hydraulic loading rates

Wastewater Source	Examples	Activity	Total Flow (L/day)
Food premises / food production	Cafés, Restaurants, Bakeries and the like.	Wastewater generated from cooking and food production operations (eg. takeaway food preparation, offsite catering food preparation, equipment and floor wash down) - excludes personal hygiene and loading for sit in customers.	Refer to Note 1
Commercial waste streams	Winery Brewery Abattoir	Bottle rinsing Wash down Processing	System must be separate and not combined with any human waste stream. Refer to Note 1
Non-human waste systems	Washdown bays Carwash Dog kennels Horse stables	Washdown	

Note:
1) System owner to propose wastewater / liquid waste hydraulic loading. Hydraulic loading must be based on peak flow events. The following controls will be implemented:

- Metering of wastewater / liquid waste volumes produced
- System owner to ensure the maximum capacity of the system is not exceeded

More information

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Last reviewed: 16-10-2019

Produced by
Public Health

ATTACHMENT C

AS 1547 Recommended Design Loading Rates for Trenches

Source: Standards Australia and Standards New Zealand (2012) *AS/NZS 1547: 2012 - On-site Domestic Wastewater Management*.

TABLE L1
RECOMMENDED DESIGN LOADING RATES FOR TRENCHES AND BEDS

Soil category	Soil texture	Structure	Indicative permeability (K_{sat})(m/d)	Design loading rate (DLR) (mm/d)			
				Trenches and beds			ETA/ETS beds and trenches
				Primary treated effluent		Secondary treated effluent	
				Conservative rate	Maximum rate		
1	Gravels and sands	Structureless (massive)	> 3.0	20 (see Note 1)	35 (see Note 1)	50 (see Note 1)	(see Note 4)
2	Sandy loams	Weakly structured	> 3.0	20 (see Note 1)	30 (see Note 1)	50 (see Note 1)	
		Massive	1.4 – 3.0	15	25	50	
3	Loams	High/ moderate structured	1.5 – 3.0	15	25	50	
		Weakly structured or massive	0.5 – 1.5	10	15	30	
4	Clay loams	High/ moderate structured	0.5 – 1.5	10	15	30	12
		Weakly structured	0.12 – 0.5	6	10	20	8
		Massive	0.06 – 0.12	4	5	10	5
5	Light clays	Strongly structured	0.12 – 0.5	5	8	12	8
		Moderately structured	0.06 – 0.12	(see Notes 2 & 3)	5	10	5 (see Notes 2, 3, & 5)
		Weakly structured or massive	< 0.06			8	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5				
		Moderately structured	< 0.06				
		Weakly structured or massive	< 0.06				

NOTES:
1 The treatment capacity of the soil and not the hydraulic capacity of the soil or the growth of the clogging layer govern the effluent loading rate in Category 1 and weakly structured Category 2 soils. Land application systems in these soils require design by a suitably qualified and experienced person, and distribution techniques to help achieve even distribution of effluent over the full design surface (see L6.2 and Figure L4 for recommended discharge method by discharge control trench). These soils have low nutrient retention capacities, often allowing accession of nutrients to groundwater.
2 To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.
3 If K_{sat} < 0.06 m/d, a full water balance for the land application can be used to calculate trench/bed size (see Appendix Q).
4 ETA/ETS systems are not normally used on soil Categories 1 to 3.
5 For Category 6 soils ETA/ETS systems are suitable only for use with secondary treated effluent.

ATTACHMENT D

SITE DATA AND PHOTOGRAPHS

TABLE D: SITE RESULTS SUMMARY

Site No	Building Envelope (BE) No	Sample depth (cm)	Lab Sample No	Topographic Unit (landform)	Site elevation (approx)	Soil Group[1]	Soil texture	Indicative Permeability[2]	Soil colour (moist)[3]	Soil acidity/alkalinity (pHw)[4]	Soil salinity (Conductivity EC 1:5 in dS/m)[5]	Soil PRI (measure of nutrient retention ability)[6]
1	-	0 – 5	-	**Outside and west of Lot 304** (gentle slope with abundant limestone)	5 m AHD	Calcareous stony soil	Sand	> 3 m / day then restricted at 5 cm by underlying limestone	Reddish brown (5YR4/4)	Moderately alkaline: 8.3	Moderately saline: 0.290	-
2	1	40 – 50 (subsoil)	1	**D** (< 4 m AHD) lowland swale – lowest part of Lot 304	2.5 m AHD	Calcareous shallow sand (just)	Sand	> 3 m / day	Brown (10YR4/3)	Moderately alkaline: 8.8	Moderately saline: 0.290	Moderate: 9.4
"	1	70 - 80 (buried soil over l'stone	2	" "			Sand	> 3 m / day then possibly restricted at 80 cm by underlying limestone	Strong brown (7.5YR5/6)	Strongly alkaline: 9.6	Highly saline: 0.829	Moderate: 16.7
3	-	40 - 50	3	**Outside and south of Lot 304** and BE 1. Undulating 2- 5 % secondary 2° dunes parallel to beach)	3 m AHD	Calc sand	Sand	> 3 m / day	Light brownish grey (10YR6/2)	Moderately alkaline: 9.0	Non-saline: 0.140	Very low: 1.7

Site No	Building Envelope (BE) No	Sample depth (cm)	Lab Sample No	Topographic Unit (landform)	Site elevation (approx)	Soil Group[1]	Soil texture	Indicative Permeability[2]	Soil colour (moist)[3]	Soil acidity/alkalinity (pHw)[4]	Soil salinity (Conductivity EC 1:5 in dS/m)[5]	Soil PRI (measure of nutrient retention ability)[6]
4	-	40 - 50	4	**Outside and south of Lot 304** and BE 1 (gradient 3% incipient foredune parallel to beach)	1.5 m AHD	Calc sand	Sand	> 3 m / day	Light brownish grey (10YR6/2)	Strongly alkaline: 9.4	Non-saline: 0.083	Very low: 1.3
5	8	10 -20	-	**C** (4-8 m AHD) dune side-slope 8%	6 m AHD	Calc deep sand	Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.7	Non-saline: 0.107	-
"	8	140 -150	-	" "			Sand	> 3 m / day	Light brownish grey (10YR6/2)	Moderately alkaline: 8.3	Non-saline: 0.140	-
6	9	10 -20	-	**C** (4-8 m AHD)	7 m AHD	Calc deep sand	Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.3	Moderately saline: 0.378	-
"	9	140 -150	-	" "			Sand	> 3 m / day	Pale brown (10YR6/3)	Moderately alkaline: 8.2	Slightly saline: 0.231	-
7	10	140 -150	6	**B** (8-12 m AHD)	9 m AHD	Calc deep sand	Sand	> 3 m / day	Pale brown (10YR6/3)	Moderately alkaline: 8.5	Non-saline: 0.086	Moderate: 6.4

Site No	Building Envelope (BE) No	Sample depth (cm)	Lab Sample No	Topographic Unit (landform)	Site elevation (approx)	Soil Group[1]	Soil texture	Indicative Permeability[2]	Soil colour (moist)[3]	Soil acidity/alkalinity (pHw)[4]	Soil salinity (Conductivity EC 1:5 in dS/m)[5]	Soil PRI (measure of nutrient retention ability)[6]
8	11	10 -20	-	**B** (8-12 m AHD) 3 – 4% undulating upper dune surface	9 m AHD	Calc deep sand	Sand	> 3 m / day	Greyish brown (10YR5/2)	Moderately alkaline: 8.4	Severely saline: 1.344	-
"	11	140 -150	-	" "			Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.9	Moderately saline: 0.424	-
9	-	10 -20	-	**Outside and south of Lot 304** and BE 12 (lowest point of upland swale)	7 m AHD	Calc deep sand	Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 9.0	Slightly saline: 0.207	-
"	-	140 -150	-	" "			Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.7	Non-saline: 0.125	Moderate: 10.4
10	12	10 -20	-	**B** (8-12 m AHD) middle of upland swale	8.5 m AHD	Calc deep sand	Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.8	Highly saline: 0.875	-
"	12	140 -150	-	" "			Sand	> 3 m / day	Pale brown (10YR6/3)	Strongly alkaline: 9.1	Slightly saline: 0.173	-
11	13	10 -20	-	**B** (8-12 m AHD) 3- 4 % upper slope	11.5 m AHD	Calc deep sand	Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.7	Highly saline: 1.095	-

Site No	Building Envelope (BE) No	Sample depth (cm)	Lab Sample No	Topographic Unit (landform)	Site elevation (approx)	Soil Group[1]	Soil texture	Indicative Permeability[2]	Soil colour (moist)[3]	Soil acidity/alkalinity (pHw)[4]	Soil salinity (Conductivity EC 1:5 in dS/m)[5]	Soil PRI (measure of nutrient retention ability)[6]
"	13	140 -150	-	" "			Sand	> 3 m / day	Pale brown (10YR6/3)	Strongly alkaline: 9.1	Slightly saline: 0.227	-
12	17	10 -20	-	**B** (8-12 m AHD)	11.5 m AHD	Calc deep sand	Sand	> 3 m / day	Brown (10YR5/3)	Moderately alkaline: 8.8	Highly saline: 0.610	-
"	17	140 -150	7	" "			Sand	> 3 m / day	Greyish brown (10YR5/2)	Moderately alkaline: 8.7	Non-saline: 0.132	Low: 3.2
13	23	140 -150	8	**B** (8-12 m AHD) 4% gradient	8.5 m AHD	Calc deep sand	Sand	> 3 m / day	Pale brown (10YR6/3)	Moderately alkaline: 8.8	Slightly saline: 0.201	Moderate: 7.0
14	-	40-50	-	**Outside and south of Lot 304** and BE 23 (2^{o} dune parallel to beach)	3 m AHD	Calc sand	Sand	> 3 m / day	Light brownish grey (10YR6/2)	Strongly alkaline: 9.2	Slightly saline: 0.148	-
15	-	40-50	-	**Outside and south of Lot 304** and BE 23 (incipient primary foredune parallel to beach)	2 m AHD	Calc sand	Sand	> 3 m / day	Light grey (10YR7/1)	Moderately alkaline: 9.0	Highly saline: 0.761	-

Site No	Building Envelope (BE) No	Sample depth (cm)	Lab Sample No	Topographic Unit (landform)	Site elevation (approx)	Soil Group[1]	Soil texture	Indicative Permeability[2]	Soil colour (moist)[3]	Soil acidity/alkalinity (pHw)[4]	Soil salinity (Conductivity EC 1:5 in dS/m)[5]	Soil PRI (measure of nutrient retention ability)[6]
16	29	140 -150	9	**C** (4-8 m AHD) gently sloping 4 % inland part of 2^{o} dune	6 m AHD	Calc deep sand	Sand	> 3 m / day	Greyish brown (10YR5/2)	Moderately alkaline: 9.0	Non-saline: 0.075	Very low: 1.7
17	31	140 -150	10	**B** (8-12 m AHD) 14% gradient	9.5 m AHD	Calc deep sand	Sand	> 3 m / day	Pale brown (10YR6/3)	Moderately alkaline: 8.5	Non-saline: 0.095	Moderate: 13.8
18	33	100-110	-	**A** (> 12 m AHD) upland dune crest inland from headland	15 m AHD	Calc deep sand	Sand	> 3 m / day	Very pale brown (10YR7/3)	Moderately alkaline: 8.5	Non-saline: 0.192	-
19	-	0 - 5	-	**Outside and south east of Lot 304** and BE 32 (gentle slope with abundant limestone – leading to headland)	-	Calcareous stony soil	Sand	> 3 m / day then immediately restricted by underlying limestone	Light yellowish brown (10YR6/4)	Moderately alkaline: 8.9	Slightly saline: 0.236	-

Footnotes to table

1. WA Soil Group (Schoknecht and Pathan 2013).

2. Indicative permeability as per ANZS 1547 Table L1 (Attachment X).

3. Soil Colour notation (Munsell 1954).

4. pH in 1:5 distilled water, with categories as per DPIRD's *Land Evaluation Standards for Land Resource Mapping* (van Gool et al 2005). Moderately alkaline: 8.0 – 9.0, Strongly alkaline: > 9.0.

5. Conductivity in 1:5 distilled water, with categories for sands as per DPIRD's *Land Evaluation Standards* (van Gool et al 2005). Non-saline: 0 – 0.14, Slightly saline: 0.15 – 0.28, Moderately saline: 0.29 – 0.57, Highly saline: 0.58 – 1.14, Severely saline: 1.15 – 2.28, Extremely saline: > 2.28 dS/m.

6. Phosphorus retention index, with categories as per DPIRD's *Land Evaluation Standards for Land Resource Mapping* (van Gool et al 2005). Very low: < 2, Low: 2 – 5, Moderate: 5 – 20, Moderately high: 20 – 100, High: > 100. See overleaf for raw data.

Analysis Results

CSBP Soil and Plant Laboratory

73114
Land Assessment Pty Ltd

		Lab No	PYS20046	PYS20047	PYS20048	PYS20049	PYS20050	PYS20051	PYS20052	PYS20053
		Name	1	2	3	4	5	6	7	8
		Code	02/04/20	02/04/20	02/04/20	02/04/20	02/04/20	02/04/20	02/04/20	02/04/20
		Customer	Land Assessment Pty Ltd	Land Assessment Pty Ltd	Land Assessment Pty Ltd	Land Assessment Pty Ltd	Land Assessment Pty Ltd	Land Assessment Pty Ltd	Land Assessment Pty Ltd	Land Assessment Pty Ltd
		Depth	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10
Conductivity	dS/m		0.355	0.829	0.140	0.083	0.125	0.086	0.132	0.201
pH Level (CaCl2)			7.8	8.4	7.8	8.3	7.3	7.2	7.5	7.5
pH Level (H2O)			8.8	9.6	9.0	9.4	8.7	8.5	8.7	8.8
Phosphorus Retention Index			9.4	16.7	1.7	1.3	10.4	6.4	3.2	7.0

CSBP Lab. Extract Value.

Analysis Results

CSBP Soil and Plant Laboratory

	Lab No	PYS20054	PYS20055
	Name	9	10
	Code	02/04/20	02/04/20
	Customer	Land Assessment Pty Ltd	Land Assessment Pty Ltd
	Depth	0-10	0-10
Conductivity	dS/m	0.075	0.095
pH Level (CaCl2)		7.6	7.3
pH Level (H2O)		9.0	8.5
Phosphorus Retention Index		1.7	13.8

CSBP Lab. Extract Value.

SUNDAY ISLAND BAY PHOTOGRAPHS

Photo 1: **View towards Lot 304 from near SITE 1**

Photo 2: **SITE 2 in BE 1 – lowest portion of Lot 304.**

Photo 3: **SITE 2 soil is a shallow (< 80 cm) calcareous sand over a buried limestone weathering surface.**

Photo 4: **Intervening 66 m of land between Lot 304 and water. Secondary dunes & incipient foredune.**

Photo 5: **SITE 3 - *Scaevola crassifolia* is a characteristic coloniser of the secondary dunes.**

Photo 6: **SITE 4 -*Spinifex longifolius* dominates the narrow incipient foredune next to the beach.**

SUNDAY ISLAND BAY PHOTOGRAPHS

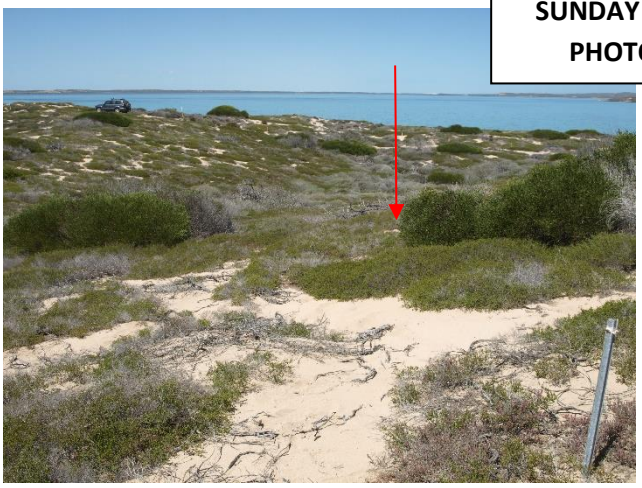


Photo 7: **SITE 5 (arrowed) - building envelope 8.**

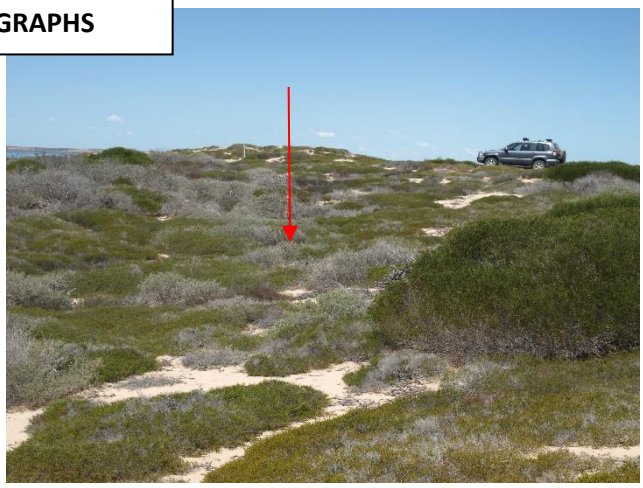


Photo 8: **SITE 6 (arrowed) - building envelope 9.**

Photo 9: **SITE 7 (arrowed) - building envelope 10.**

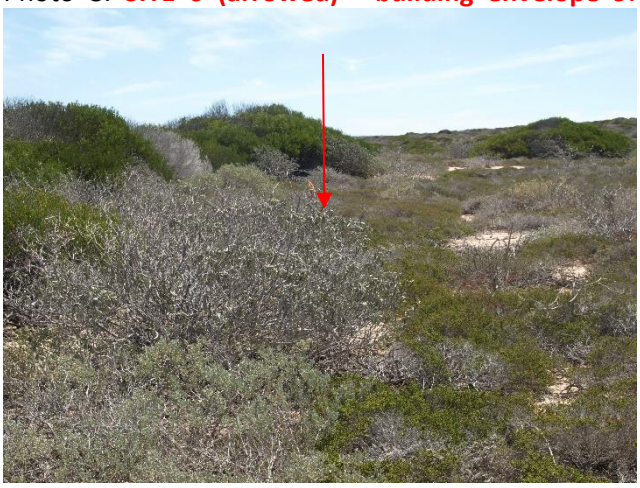


Photo 10: **SITE 8 (arrowed)- building envelope 11.**

Photo 11: **SITE 9 – outside Lot 304, the lowest point of the elongated swale in building envelope 12.**

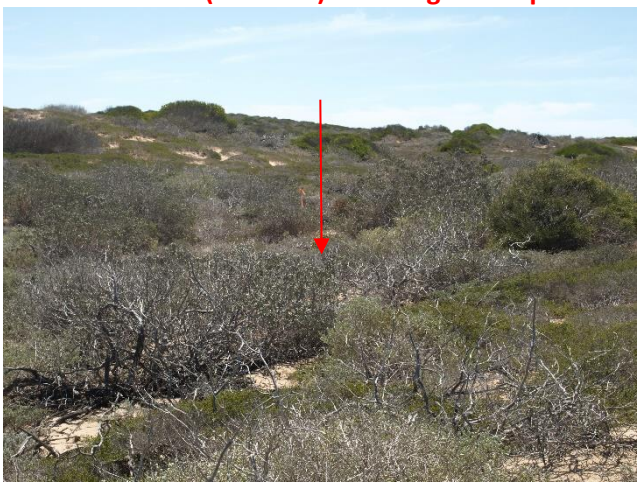


Photo 12: **SITE 10 (arrowed)- building envelope 12.**

SUNDAY ISLAND BAY
PHOTOGRAPHS

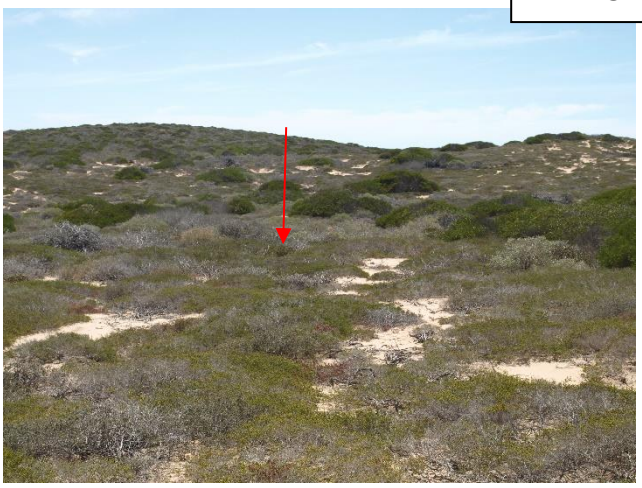


Photo 13: **SITE 11 (arrowed) - building envelope 13.**

Photo 14: **SITE 12 (arrowed) - building envelope 17.**

Photo 15: **View westwards of parabolic dunes from just upslope of building envelope 17.**

Photo 16: **SITE 13 (arrowed) - building envelope 23.**

Photo 17: **View southwards from SITE 13 - building envelope 23. Intervening 72 m of land between Lot 304 and water. Sloping edge of parabolic dune in foreground, then 2° dune and incipient foredune.**

Photo 18: **SITE 14 -- *Scaevola crassifolia* is common in the hummocky secondary dunes in front of building envelope 23.**

SUNDAY ISLAND BAY PHOTOGRAPHS

Photo 19: **SITE 15 -*Spinifex longifolius* dominates incipient foredune in front of building envelope 23.**

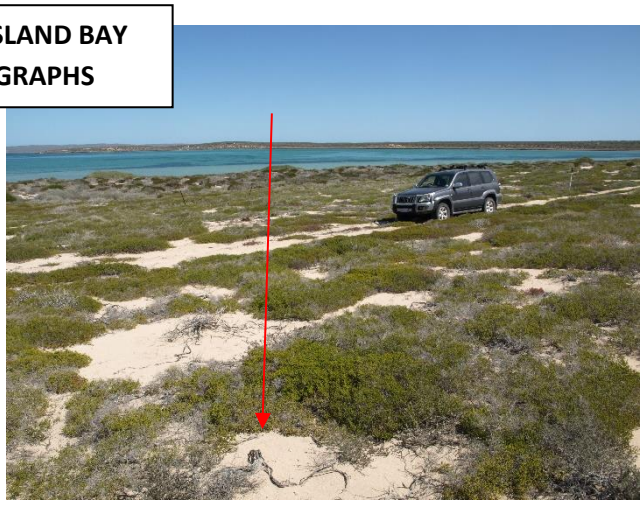


Photo 20: **SITE 16 (arrowed) - building envelope 29 within windblown inland extension of the 2° dune.**

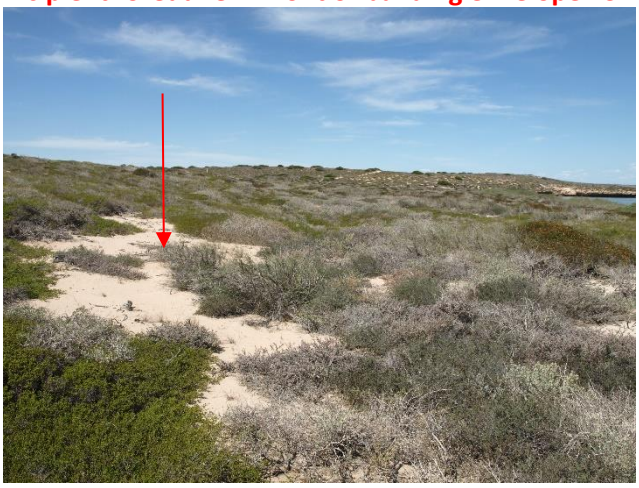


Photo 21: **SITE 17 (arrowed) - building envelope 31.**

Photo 22: **SITE 18 (arrowed)- building envelope 33.**

Photo 23: **View westwards from near building envelope 33. Track is seaward edge of Lot 304.**

Photo 24: **SITE 19 (arrowed)- South of eastern end of Lot 304. Very shallow calcareous stony soil over limestone (caprock).**

ATTACHMENT E

FUJICLEAN BROCHURE

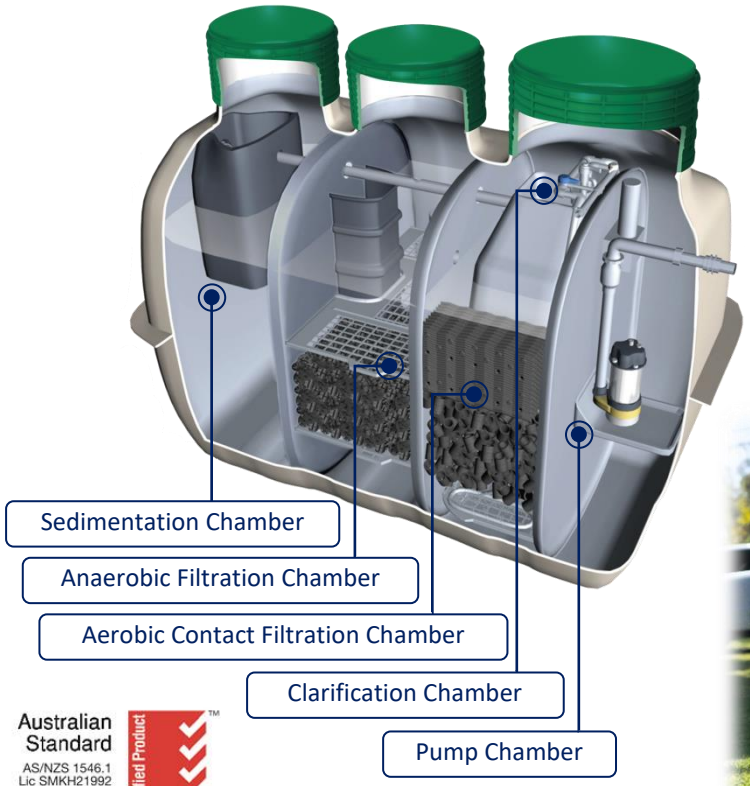
Source: Standards Australia and Standards New Zealand (2012) *AS/NZS 1547: 2012 - On-site Domestic Wastewater Management*.

FujiClean
Wastewater Treatment Systems

Towards Clean Water
Fuji Clean Australia Pty Ltd
ABN 74 129 181 317
1300 733 619
www.fujiclean.com.au

Advanced Wastewater Treatment System

FujiClean CE-1500EX AWTS



Australian Standard
AS/NZS 1546.1
Lic SMKH21992
AS/NZS 1546.3
Lic SMKH21993
SAI Global
Certified Product

10 EP | **1,500** L/day | **Advanced** Secondary

The FujiClean CE-1500EX Aerated Wastewater Treatment System successfully treats all household wastewater to advanced secondary quality, enabling the recycled water to be used for lawn & garden irrigation.

COMPACT
- Lightweight single tank design
- Minimal footprint
- Visually discrete installation

SAFE & SECURE
- Produces high quality treated effluent
- Treatment process contained inside the tank
- Alarm monitor protection

EFFICIENT
- Light weight transport & installation
- Low operation and running costs (47W Blower)
- Minimum maintenance requirements

SUSTAINABLE
- Extended service life - 15 years minimum
- Reuse all water for garden and lawn irrigation
- Minimal environmental impact

RELIABLE
- Proudly manufactured in Australia
- Effectively handles shock loading
- Dependable quality & performance

PROVEN DESIGN
- 50 Years experience with wastewater treatment
- Continued research & development
- 50,000 installations per year worldwide

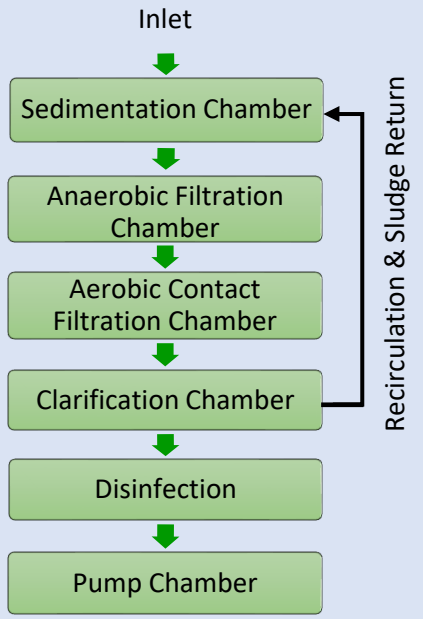
World Leaders in Onsite Wastewater Treatment Technology

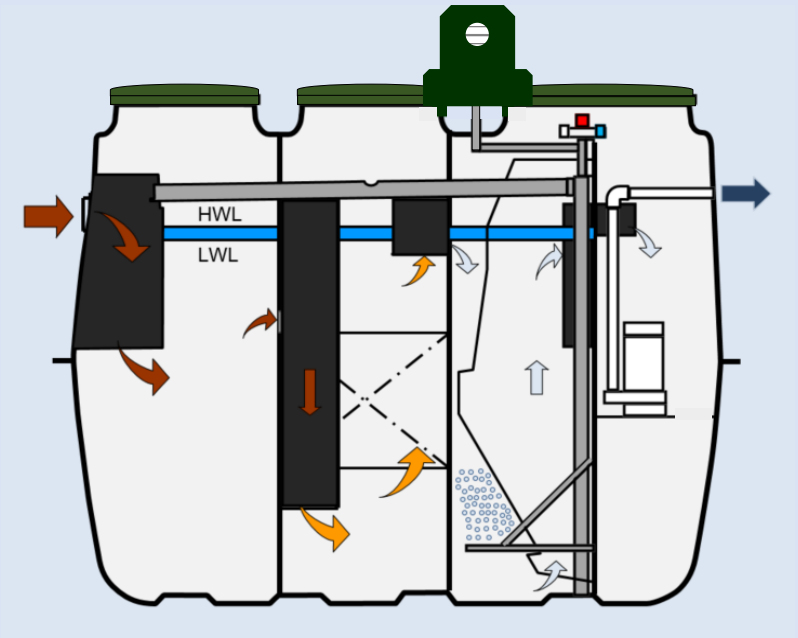
FujiClean
Wastewater Treatment Systems

Towards Clean Water

Fuji Clean Australia Pty Ltd
ABN 74 129 181 317
1300 733 619
www.fujiclean.com.au

FujiClean Treatment Process & Flow Diagram





NOTE: The 6 stage treatment has been developed by FujiClean & is known as: Contact Media Filtration Process - CMFP

Warranty

Structural Tank	15 years
Electrical Components	2 years

Treatment: Advanced Secondary

BOD	<10mg/L
SS	<10mg/L
E.coli	<10cfu/100ml

Nutrient Removal
54% Nitrogen Reduction
87% Phosphorus Reduction

NOTE: The FujiClean CE-1500EX is approved for use in all states and territories of Australia.

System Dimensions

Weight (empty)	430kg
Length	2,510mm
Width	1,440mm
Height – No risers	1,870mm
Height – 300mm risers	2,170mm
Height – 500mm risers	2,370mm
Inlet Invert Options	500, 800 or 950mm
Inlet Pipe	100mm dia
Outlet Pipe	40mm dia

Working Capacity

Sedimentation Chamber	1,114L
Anaerobic Filtration Chamber	982L
Aerobic Filtration Chamber	580L
Clarification Chamber	281L
Pump Chamber	308L
Total Working Capacity	3,265L
Emergency Storage	1,094L
Total Volume	4,359L
Aeration – MAC80 (47W)	80L/min

ATTACHMENT F

APPROVED LEACH DRAINS
(with infiltrative areas)

Source: Department of Health website https:ww2.health.wa.gov.au

Accessed April 2 2020

Approved leach drains

The Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulation 1974 (external site) requires leach drains to be approved by the Chief Health Officer.

The following tables details the specifications of concrete leach drains (Table 1) and non-concrete leach drains (Table 2) approved for use in Western Australia for the onsite disposal of wastewater.

Table 1: Approved concrete leach drains

Manufacturer	Phone	Infiltrative area (m^2/m)	Module length (m)
Altham Plumbing Contractors	91911561	1.94	0.9
Avon Septics and Backhoe Hire	95742543	1.91	1.5
B.Co Rural		1.535	1
Bunbury Cement Products	97914344	1.91	1.335
Bunbury Modular Brick	97254566	1.48	1.5
Busselton Cement Products (aka WA Septics)	0403208621	1.82	1.8
		1.48	Varies
C & BJs Concrete Supplies	97331008	2.06	1.86
Collie Steel Supplies	97343535	2	1.5
Concrete Products Esperance	90711271	1.59	1.52
Concrete World Esperance	90711058	1.686	1.5
Cuballing Concrete and Contractors	98836333	1.65	1.8
Dalwallinu Concrete Works	96611264	1.51	1.2
Denmark Concrete PL	98482920	1.43	2.0
Dongara Concrete Services	99271096	1.43	1.5
Galvin Concrete & Sheetmetal	93022175	1.58	1.2
GNC Quality Precast	99233705	2.02	1.2
Hester Concrete Products		1.45	1.4
Hills Concrete Products (Northam)	0427225876	1.58	1.2
Hockley's Denmark Plumbing Service (aka. Denmark Concrete Constructions)	98481210	1.36	1.5
Jandakot Cement Works	94179372	1.44	1.2
Kimberley Septics	91935440	1.33	1
Kondinin Concrete Products	98891031	1.82	1

LAB Concrete Products	97541111	1.81	1.2
Maddington Concrete Products	94591053	1.8	1.2
Manjimup Concrete Manufacturers	97771666	1.72	1.2
Midland Cement Products	94490200	1.49	1.2
MJB Industries	97970999	1.4	1.5
Moora Concrete Works	96511174	1.8	1.2
Mundaring Concrete	92951566	1.9	1.2
Naval Base Concrete	94393933	1.65	1
PN & ER Newman's Quality Concrete Products	98422040	1.82	1.2
Regal Precast Concrete Products	92493322	1.78	1.21
Thompson Building Industries	98838188	1.975	1.5
Toodyay Septics & Backhoe Hire	95744177	1.94	2.35
UDUC Concrete Products	97293301	1.74	2.4
Vanmaris Concrete Products	97555110	1.6	2
		1.7	1
WANT Plumbing	0428354009	1.71	1.21
Wheatbelt Concrete Products	92746988	1.68	1.2
		1.45	2.4
		1.67	3
Winchester Industries	96521967	1.82	1.5
Yuella Fabrications	99801339	1.73	1
ZTD	0411326740	1.48	1.2
			1.5
			2.4

Table 2: Approved non-concrete leach drains

Manufacturer	Model	Infiltrative area (m^2/m)	Module length (m)
ADS Pipe PL 0432 184 470	Stormtech	2.0	0.864
All Drainage Systems PL Plumbtec Plumbing Supplies: 9455 1444 Tech Plumbing: 9274 1540 Reece PL: 9328 5765	ADM Drain	1.19	0.356
Atlantis Corporation PL (02) 94178344	Flotank Atlantis	1.3	0.685
	Flatbed	2.6	2.4
Ausdrain (02) 9810 8335	Ausdrain EnviroModule2	1.3	0.6
Elmich Australia PL			

(02) 9648 2073 **WA Distributor:** Geofabrics Australasia PL: (03) 8586 9199	Versitank	1.62	0.5
Everhard Industries PL EF Hodge & Co 9328 6644	#230	0.89	1.5
	#350	1.15	1.5
	#410	1.28	1.5
Filtrex Innovative Wastewater Solutions (08) 9726 0118	Filtrex Leach Drain Cage	0.9	1.2
	Filtrex Leach Drain Cage MK2	1.5	0.8
Geofabrics Australasia PL (03) 8586 9199	Megatank	1.4	0.75
Global Synthetics PL 9459 4300	Protank	1.29	0.72
Graf Plastics Australia 9437 4949	Graf Sicker Tunnel 300L	1.52	1.16
Novaplas PL 6250 3000	Drainwell DW1592	1.28	0.755
	Drainwell DW2592	1.635	0.4
Rainsmart Solutions PL DS Agencies 6143 6565	Rainsmart L	1.28	0.72
	Rainsmart W	1.6	0.4
	DS Angencies Flatbed	2.4	0.5
Reln Plastics PL Galvin Engineering Pty Ltd 9249 5900	Jumbo	1.31	1.517
	Large	1.23	1.517
	Standard	0.92	1.517
Sentry Holdings PL (08) 9244 1456 OR 0409 519 259	Tunnelwell Arch System	2.53	2.05

Length of leach drains required

To determine the length of leach drains required, use the following formula:

Soil Type	Residential dwelling bedrooms			Commercial
	2 or less	3	4 or more	
Primary Treated Effluent (Septic Tanks)				
Sand	18.8 ÷ IA	25.4 ÷ IA	27.6 ÷ IA	Hydraulic loading (L/day) ÷ 30 ÷ IA
Loams and gravels	28.2 ÷ IA	38.1 ÷ IA	41.5 ÷ IA	Hydraulic loading (L/day) ÷ 20 ÷ IA
Other	To be calculated basing on infiltration rates recommended in AS/NZS 1547			
Secondary Treated Effluent (Aerobic Treatment Units / Wastewater Treatment Plants)				
Sand / Gravel / Loam	Hydraulic loading (L/day) ÷ 50 ÷ IA			
Clay Loam	Hydraulic loading (L/day) ÷ 30 ÷ IA			

Light Clay	Hydraulic loading (L/day) ÷ 12 ÷ IA

IA = Infiltrative area of drain

More information

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ATTACHMENT G

SCHEDULE 2 from GOVERNMENT SEWERAGE POLICY

Source: Government of Western Australia (2019,a)

Government Sewerage Policy

SCHEDULE 2:
Site requirements for on-site sewage systems

1 Minimum lot sizes for residential development in heavy soils

Table 1: Minimum lot sizes for residential development serviced by on-site sewage disposal in heavy soils located outside public drinking water source areas and sewage sensitive areas outside of Perth Metropolitan and Peel Region Scheme Areas.

Soil category[5]	Soil texture	Minimum lot sizes m² (R-code)[6]	
		Primary treatment	Secondary treatment
4	Clay loams	2,000 (R5)	1,000 (R10)
5	Light clays	4,000 (R2.5)	1,000 (R10)
6	Medium to heavy clay	Special design requirements and distribution techniques or soil modification procedures will be necessary. Refer to Table L1 of AZ/NZS 1547 for more details.	2,000 (R5)
-	Rock	Special design requirements and distribution techniques or soil modification procedures will be necessary.	

Refer to section 5.2 for minimum lot sizes in public drinking water source areas and sewage sensitive areas.

[5] Soil categories, extrapolated from Table 5.1 AS/NZS 1547, are to be determined by undertaking a site and soil evaluation (SSE) as per *AS/NZS 1547 On-site domestic wastewater management*.

[6] Minimum lot sizes are based upon area required to accommodate dwelling, primary on-site sewage system, land application areas and associated setback distances.

2 Determination of land application area (m²)

The size of the land application area should be determined in accordance with the conversion factors prescribed in Table 2 and *AS/NZS 1547 On-site domestic wastewater management* as follows:

1. Estimate hydraulic load (L/day):
   - occupancy rate (persons) x design loading rate (L/person/day)
2. Calculate land application area (m²):
   - hydraulic load (L/day) x conversion factor from Table 2

Table 2: Conversion factors to calculate the minimum required land application area for subdivision/ development (conversion factors are determined using a hydraulic load of 1 L/day.

Soil category	Soil texture	Conversion factors	
		Primary treatment	Secondary treatment
1	Gravels and sands	0.377	0.2
2	Sandy loams	0.377	0.2
3	Loams	0.477	0.25
4	Clay loams	0.689	0.286
5	Light clays	1.284	0.333
6	Medium to heavy clays	Special design requirements and distribution techniques or soil modification procedures will be necessary	0.5

3 Land application areas for single houses

Table 3: Land application areas for a single house (occupancy of 6 persons in a 5 bedroom house)

Soil category	Soil texture	Land application area (m^2) [7]	
		Primary treatment (includes area required for setbacks)	Secondary treatment (excludes setbacks)
1	Gravels and sands	339	180
2	Sandy loams	339	180
3	Loams	429	225
4	Clay loams	620	257
5	Light clays	1,156	300
6	Medium to heavy clays	Special design	450

This table may be used to inform residential subdivision applications. It is based upon Table 2. Different sized areas may be required at development or building stage in response to anticipated hydraulic load.

A sample calculation for determining the land application area for a primary treatment system in Soil Categories 1 and 2 is provided in the Explanatory Notes.

[7] The land application area has been determined using design loading rates for trenches and beds, extrapolated from Table L1 *AZ/NZS 1547 On-site domestic wastewater management*. Calculations used a hydraulic loading of 900litres/day, which is based on the occupancy of 6 persons in a 5 bedroom house and a sewage design flow of 150L/person/day. Values for primary treatment include setback distances. Note that values for secondary treatment exclude setback distances, which will vary depending on the system used.

4 General site features for on-site sewage disposal

Table 4: General site features for on-site sewage disposal

Site feature	Minimum requirement
Separation from groundwater – outside public drinking water source areas and sewage sensitive areas **(The minimum requirements for public drinking water source areas and sewage sensitive areas are found at Section 5.2 of this policy)**	Where land is not within a public drinking water source area or a sewage sensitive area[8], the discharge point of the on-site sewage system should be located the following distances above the highest groundwater level: • for loams and heavy soils, at least 0.6 metres • for gravels, at least one metre • for sands, at least 1.5 metres. Where a nutrient retentive secondary treatment system is used, at least 0.6 metres.
Land application area	A land application area should be provided for all development in accordance with tables 2 and 3 of this schedule for the disposal of sewage.
	The land application area excludes the area restricted to the distribution of treated sewage only and should be kept free of any temporary or permanent structures.
	Activities within the land application area shall not interfere with the function of the current and future land application system and people should avoid potential contact with effluent residues. Unless allowed for in the design, the land application area) should: • not be built on or paved in a manner which precludes reasonable access; • not be subject to vehicular traffic (other than a pedestrian-controlled lawnmower); • not be subject to regular foot traffic such as pathways and clothes line areas; and • should be kept in a manner which enables servicing and maintenance of the disposal system.
Gradient of the land application area	Where slope exceeds one in five (1:5), the land application area should be engineered to prevent run-off from the land application area. Surface contours should be provided on the site plan.
Location of land application area within building envelope	Local government may approve the location of land application areas outside building envelopes where proposed location meets requirements outlined above.

[8] The minimum separation distances for sewage sensitive areas and public drinking water source areas are provided in Section 5.2 of this policy.