Whitehead & Associates
Environmental Consultants

Alon Musael
Isa Designs

(via email: alon@isadesigns.com.au)

3 December 2020

Dear Alon,

Onsite Wastewater Management Plan for The Noble Craft Home Distillery, 271 Powderworks Road, Ingleside, NSW

Whitehead & Associates (W&A) has been engaged to prepare an Onsite Wastewater Management Plan for The Noble Craft Home Distillery operation.

Introduction

We understand that you have lodged a Development Application with Northern Beaches Council ("Council") for a home distillery to operate at 271 Powderworks Road, Ingleside, NSW. Improvements on the property include a two storey plus attic 4 bedroom dwelling and an outbuilding with garaging on the ground floor and storage above, along with a small shed, water tanks and an onsite sewage management (OSSM) system. It is proposed to convert part of the outbuilding for the distillery. It is understood that the property is not connected to town water or sewer services and relies on on-site collection of water and wastewater disposal; however, some water will be imported onto the site for use in the distilling operation.

Inspection of aerial photography indicates that much of the site has very shallow soils or surface rock outcrop, with the exception of the garden area to the south-west of the garage building, where the soils have been improved and lawn is established.

In their review of documentation submitted, Council have requested that further information be provided relating to on-site wastewater management.

Environmental Health Referral Response - commercial use dated 9 October 2020 indicates that:

Wastewater from the processing of the products will dispose to the onsite wastewater system already approved. Town water supply is used in all sinks and preparation of the food products. Any rainwater use will be suitably conditioned.

Environmental Health Referral Response – unsewered land dated 12 October 2020 notes that:

Environmental Health has reviewed the information and plans submitted as part of the proposal and has determined limited information has been provided to effectively assess the disposal of waste on the property through an onsite sewage management system. This is due to an expected increase in litreage from the commercial operation.

The applicant is required to submit an on-site sewage management site and soil assessment by a suitably qualified person with the following information.

1. Number of staff proposed in the operation of the distillery, number of bedrooms in the dwelling and the expected litres per day.

2. Details on the current wastewater system and a recommendation on if it should be retained or if further system/s are required.

3. Design details on the existing onsite sewage management facility on the property including but not limited to the disposal area, soil types/ profiles.

In addition, the current onsite wastewater approval for the residential dwelling has expired (May 2020), therefore an application for approval to operate an onsite sewage management system will need to be submitted to Council as part of this proposal.

This report provides a capacity assessment of the existing onsite wastewater treatment and land application systems to determine if they have sufficient capacity for the proposed development and provides supporting documentation for Council in response to their request.

Capacity Assessment of Existing Onsite Wastewater System

Council records indicate that the existing onsite wastewater system at the property is a Taylex Clearwater 90 Compact Aerated Wastewater Treatment System (AWTS). The system was installed in 2000 and at the time of installation had a valid NSW Health Certificate of Accreditation. A copy of NSW Health Certificate of Accreditation AWTS003 is appended (Appendix 1). The system is designed to treat a daily hydraulic load of 1,500 litres. Council records and review of historic aerial photographs of the site indicate that the effluent is irrigated over an area of approximately 270m^2 of improved lawns to the south-west of the outbuilding and this area appears to be operating in a satisfactory manner.

The system services a four bedroom dwelling.

Based on a nominal occupancy of six persons in the four bedroom dwelling and a typical daily wastewater design flow of 120 litres/person/day for a dwelling with onsite roof water tank supply, the total daily hydraulic load is 720 litres/day. **This represents a daily hydraulic load of 48% of the capacity of the treatment system, with a surplus treatment capacity of 780 litres/day.**

The proposed distillery will operate as a home based business with two staff, one of whom is a resident of the property. A wastewater design flow allowance of 30 litres per day is made for the second, non-resident, staff member in line with the recommendations of the NSW Health Septic Tank and Collection Well Accreditation Guideline December 2001 and Australian New Zealand Standard AS/NZS1547:2012.

The distillery will utilise 2,000 litres per month of imported water to produce 70 litres per day (1,400 litres per month) of spirits. The distilling operation will generate of the order of 30 litres of spent wash per day. This will be captured in a 1,000L container, integral to the still, to be collected and disposed of offsite, by a licenced liquid waste disposal contractor.

Clean, new, sterilised bottles will be filled with spirit, so no water will be utilised in bottle washing and no sterilisation of bottles will take place on the premises.

The distillery will generate approximately 50 litres per day of washing up water.

The overall additional wastewater to be managed by the existing wastewater treatment system will comprise:

Allowance for one non-resident staff member:	30 litres per day
Washing up water:	50 litres per day
Total:	**80 litres per day**.

This additional quantity of wastewater is expected to be of domestic strength and is well within the limit of available capacity of the existing wastewater treatment system.

The combined total daily hydraulic load for the existing dwelling and the proposed distillery is 800 litres per day.

Site and Soil Assessment

No site inspection has been undertaken as part of this investigation. The following assessment has been made by desktop study.

The existing land application is by surface irrigation on an Effluent Management Area (EMA) of approximately 270m^2 of improved lawned garden to the south-west of the garage outbuilding to be used for the proposed distillery. This EMA appears to be operating satisfactorily. This site and soil assessment describes the current status of the EMA.

A description of the Site physical constraints and the degree of limitation they pose to OSSM is provided in the table below. Reference is made to the rating scale in Table 4 of NSW DLG (1998).

<table>
<tr><th colspan="5">SITE ASSESSMENT</th></tr>
<tr><th>Parameter</th><th colspan="2">Data / Observation</th><th>Reference</th><th>Classification / Outcome</th></tr>
<tr><td>Climate</td><td colspan="2">Median Rainfall – 2004-2020 (16 years)
Mean Evaporation – 1955-1966 (11 years)
Temperate climate with median annual rainfall of 880.8mm; monthly minimum 27.6mm (May) and maximum 128.6mm (March). Rainfall exceeds potential evaporation for four months of the year. Mean annual evaporation is 1,068.9mm.</td><td>BoM Stations 066059 and 066062</td><td>Minor /Moderate limitation</td></tr>
<tr><td colspan="2">Hydraulic balance (monthly) attached:</td><td>Yes</td><td colspan="2" rowspan="4">(See below)
per NSW DLG (1998) and AS/NZS 1547:2012 procedures</td></tr>
<tr><td colspan="2">Nutrient balance (annual) attached:</td><td>Yes</td></tr>
<tr><td colspan="2">Land application area sizing attached:</td><td>Yes</td></tr>
<tr><td colspan="2">Wet weather storage requirement:</td><td>Possible</td></tr>
<tr><td colspan="2">Flooding
Land application area above 1:20 ARI flood level:
Land application area above 1:100 ARI flood level:
Electrical components above 1:100 ARI flood level:</td><td>Yes
Yes
Yes</td><td rowspan="4">Northern Beaches Council (2019) Flood Study indicates the Site is not flood affected.</td><td rowspan="4">Minor limitation</td></tr>
<tr><td>Exposure</td><td colspan="2">Majority of the available EMA is cleared with lawn throughout.
Northerly aspect; good exposure to sun and prevailing wind.</td><td>Minor limitation</td></tr>
<tr><td>Slope</td><td colspan="2">~2-4% slope across the EMA.</td><td colspan="2">Minor limitation</td></tr>
<tr><td>Landform</td><td colspan="2">Exposed plateau surfaces, convex ridges.</td><td colspan="2">Minor limitation</td></tr>
<tr><td>Run-on and Seepage</td><td colspan="2">No evidence of run-on or up-slope seepage observed from aerial photography.</td><td colspan="2">Minor limitation</td></tr>
</table>

Erosion Potential	No erosion evident within the EMA; generally good vegetation cover.	Minor limitation
Site Drainage	Well-drained. No signs of surface saturation.	Minor limitation
Fill	Landscaped garden area has been levelled and soils improved.	Minor limitation
Groundwater	Bureau of Meteorology Groundwater Explorer bore registry indicates no bores are located within 250m of the Site. The NSW DLG (1998) recommended 250m buffer distance to domestic groundwater bores can therefore be achieved. Permanent groundwater is expected to be at >10m depth within the available EMA.	Minor limitation

Applicable Buffers		
Permanent rivers and creeks (100m):	Yes	Achievable
Intermittent watercourses, drainage channels and dams (40m):	Yes	Achievable
Domestic groundwater bores (250m):	Yes	Achievable
Other sensitive receptors:	N/A	N/A
Lot boundaries (3m if EMA downslope-6m if EMA upslope):	Yes	Achievable
Buildings, driveways and swimming pools (3m if EMA downslope-6m if EMA upslope):	Yes	Achievable
Limiting horizon (groundwater, bedrock etc.) (0.6m):	Yes	Achievable

Surface Rock / Outcrop	No surface rocks or rock outcrops were visible on aerial photography of the EMA.	Minor limitation
Effluent Management Area (EMA)	Majority of the Site is improved (buildings, driveway or open heathland). The only currently available EMA is within the existing landscaped gardens. Approximately 270m² of available EMA is identified on the property.	Minor/Moderate limitation

Concluding Remarks

No major constraints to OSSM appear to exist at the Site. See further discussion below about required EMA. Identified limitations can be mitigated and/or accommodated through appropriate OSSM system location, possible wet weather storage and conservative EMA sizing and design.

A description of the soil constraints and the degree of limitation they pose to OSSM is provided in the table below. Reference is made to the rating scale in Table 6 of NSW DLG (1998).

SOIL ASSESSMENT (physical)			
Parameter	**Data / Observation**	**Reference**	**Classification / Outcome**
Soil Depth	Natural soil depths vary from 200mm - 1,000mm. Soils in the existing EMA have been improved.	Moderate limitation	
Soil Profile	A: 0-250mm, loamy sand (Cat 2). B: 250-1,000mm, clayey sand to sandy clay loam (Cat 3/4).	Minor limitation	
Depth to Water Table	Permanent groundwater is expected to be at >10m depth within the available EMA. Seasonally perched watertables may occur above the bedrock.	Minor/Moderate limitation	
Coarse Fragments (%)	<0-20% (<50mm).	Minor limitation	
Soil Permeability	<0.5-1.5m/day (inferred).	Based on high to moderately structured sandy clay loam (Cat 4)	Minor limitation
Modified Emerson Aggregate Class (EAT)	Topsoil: stable. Subsoil: occasional slight dispersion.	Minor/Moderate limitation	
Soil Landscape	The Site is located on the Lambert (la) Soil Landscape. Topography consists of exposed plateau surfaces and broad convex crests on Hawkesbury Sandstone with local relief 20-120m and slope gradients generally <20%. Limitations include seasonal waterlogging, rock outcrop, shallow depth, erosion hazard and perched watertables (localised).	eSPADE v2.1	

Concluding Remarks

Site soils are characterised by loamy sand topsoil to ~250mm, underlain by clayey sand to sandy clay loam subsoil to ~1,000mm. Soil structure is generally apedal massive to moderately pedal.

No additional soil sampling or testing has been undertaken as part of this investigation.

Based on identified soil characteristics a (maximum) design irrigation rate (DIR) of 3.5mm/day is recommended for irrigation systems, with reference to Table M1 AS/NZS 1547:2012 for Category 4

subsoils.

Natural soil conditions have been improved across the current EMA as is evident by the uniform grass cover.

Available and Required Effluent Management Area

On the basis of the above site and soil assessment the available EMA is 270m². A DIR of 3.5mm/day is recommended.

The OSSM system was approved for installation in 2000 according to regulatory requirements prevailing at the time.

If the required EMA is calculated using the loading rate approach described in the Standard AS/NZS 1547:2012; the expected daily hydraulic load of 800 litres (with increase for the distillery operation included), applied at an appropriate DIR of 3.5mm/day for the Category 4 soils, results in a required EMA of 229m^2, in which case the existing EMA would be sufficient to manage the hydraulic load. If the required EMA is calculated by water balance (Appendix 2), the water balance indicates that the EMA is likely to become saturated in six months of the year.

This could be remedied by retaining the current 270m^2 of EMA and providing wet weather storage of 20m^3 (20m^3 wet weather storage tank) and soil moisture sensors to automatically manage irrigation from the wet weather storage following periods of rain when the soil moisture level permits.

This is the preferred option and is justified on the basis that the current EMA is operating satisfactorily and that it can be demonstrated by water balance that the available area is adequate to manage the daily hydraulic load at an appropriate design loading rate with 20m^3 of wet weather storage.

The following other alternatives have been explored.

A nutrient balance undertaken for the site indicates that areas of 350m^2 and 538m^2 are required respectively for assimilation of nitrogen and phosphorus. Currently no additional area allowance for nutrients is made, however, the site is plenty large enough to allow for a suitably sized downslope (to the south-west of the existing EMA) nutrient buffer of approximately 270m^2.

To manage the nutrients in a more formal EMA would require an increase of the current EMA by a further 270m^2.

By increasing the EMA to 540m^2, the nutrients would be appropriately managed, but there would still be a requirement for wet weather storage, albeit reduced to some 12m^3 (12m^3 wet weather storage tank).

To adequately manage the entire daily hydraulic and nutrient loads by irrigation, without recourse to wet weather storage, an EMA of 1,015m^2 is required. This option would require an additional 745m^2 of EMA to be installed.

The additional EMAs described above are shown on Figure 1. The north-eastern portion of this area is underlain by soils of the Lambert soil profile, typically 200-1,000mm of sandy loam, overlying 100-400mm of sandy clay loam. The south-western portion of this area is underlain by soils of the Oxford Falls soil landscape, typically 300mm of loamy sand overlying 200-1,000mm of clayey sand. The boundary between the soil landscapes is shown on Figure 1 and roughly bisects the proposed area of additional EMA. Both soil profiles are suitable for the additional EMA and for irrigation at a DIR of 3.5mm/day.

As soil depths are variable, these should be checked throughout the additional EMA and, for any of the above increases of EMA, it will be necessary to improve the otherwise heathland soils and

vegetation to a similar extent and standard to the current EMA, i.e. with a minimum of 600mm of clay loam soil and turf, to extend the available area for irrigation.

Figure 1 Location of existing and proposed EMA

The various options are tabulated below and relevant water and nutrient balances presented in Appendix 2.

Effluent Management Area Options

Option	Total EMA required	Additional EMA required	Wet Weather Storage (Tank)	Nutrient Assimilation Area
	m^2	m^2	m^3	m^2
1	270	0	20	Downslope nutrient buffer
2	540	270	12	Adequate
3	1,015	745	0	Adequate

The client has identified Option 1 as the preferred option.

If either of the Options 2 or 3 requiring construction of additional EMA are selected, it is recommended that the additional EMA be installed to the south-west of the existing EMA, where sufficient additional land is available.

Irrigation of the additional EMA would be best managed by installation of an indexing valve to divide the required area into 3 or 4 zones. The location of the existing and proposed additional EMA is shown in Figure 1.

Approval Status of Existing Treatment System

It is noted that the Approval to Operate the existing Taylex Clearwater 90 Compact AWTS has expired (May 2020). This is most probably because there is not a current service contract in place. It is a requirement that a current service contract be in place for an Approval to Operate to be issued and that the Council be in possession of certification from a Council approved service agent that the OSSM be in sound order and operating sustainably.

It is recommended that the owner engage a Council approved service agent to service the system and provide necessary documentation to Council and that an application for an Approval to Operate be submitted to Council.

The existing AWTS is considered suitable for continued use subject to it being serviced and any necessary maintenance undertaken to enable Council to issue an Approval to Operate.

Conclusions and Recommendations

- The existing dwelling and the proposed distillery operation with one additional non-resident staff member are expected to generate a total daily hydraulic load of 800 litres. This is well within the treatment capacity of the existing Taylex Clearwater 90 Compact AWTS.
- The existing Taylex Clearwater 90 Compact AWTS is suitable for continued use subject to it being serviced and any necessary maintenance undertaken to enable Council to issue an Approval to Operate.
- The existing EMA is of 270m^2 in area, is operating satisfactorily and should continue to operate. The soils in the existing EMA are conservatively assessed to be moderately structured sandy clay loam (Cat 4), suitable for irrigation with secondary treated and disinfected effluent at a DIR of 3.5mm/day.
- The existing EMA is of a sufficient area to manage the daily hydraulic load based on a loading rate of 3.5mm/day, but nutrients which require 350m^2 and 538m^2 for assimilation of

nitrogen and phosphorus respectively are managed by a nominal downslope nutrient buffer of approximately 270m^2.

- A water balance indicates that an EMA of 1,015m^2 is required to sustainably manage the hydraulic and nutrient loads, with no wet weather storage.
- Should an EMA of less than 1,015m^2 be installed, wet weather storage will be required.
- Should the EMA be extended to accommodate the above, it will be necessary to improve the soils in the extended EMA so that the area is level, the soils are a minimum of 600mm deep, are of clay loam or better in texture, and that the area is turfed.
- The surface irrigation system should be extended to enable uniform irrigation of the entire EMA.
- It is recommended that, if the irrigation area is expanded, irrigation be managed in 3 or 4 zones of equal size using an indexing valve.
- As treatment will be to secondary standard with disinfection, no reserve irrigation area is required.

If you have any questions or require any further information, please do not hesitate to contact me.

Yours Sincerely,

Joe Whitehead

Principal

197 Main Road Cardiff NSW 2285 Australia Telephone + 61 2 4954 4996
Email mail@whiteheadenvironmental.com.au Website www.whiteheadenvironmental.com.au

Appendix 1

NSW Health Accreditation

NSW HEALTH
DEPARTMENT

CERTIFICATE OF ACCREDITATION
Aerated Wastewater Treatment System

This is to certify that the

Taylex Clearwater 90 compact Aerated Wastewater Treatment System

manufactured by:

Taylex Queensland Pty Ltd
14 Activity Crescent
Ernest QLD 4214

has been accredited by the NSW Department of Health as a Sewage Management Facility under the provisions of Clause 43(1), Local Government (Approvals) Regulation 1999 subject to the conditions of accreditation specified in Schedule 1, and in accordance with the AWTS Accreditation Guidelines of September 1998.

Plans and Specifications:

The Taylex Clearwater 90 compact one tank aerated wastewater treatment system consists of:

- A primary sedimentation chamber with a capacity of 2886 litres;
- A contact aeration chamber with a capacity at LWL of 2367 litres;
- A sedimentation/clarifier chamber with a capacity of 757 litres containing Taylex standard PVC Biomass panels;
- A Zabel A100 effluent filter located on the outlet of the clarifier;
- A irrigation pump chamber with a capacity of 710 litres incorporating a capacity of 300 litres for chlorine contact of the effluent;
- A chlorine disinfection unit installed on the outlet pipe of the clarifier after the Zabel filter;
- Air is supplied to the contact aeration chamber by a Taylex fine bubble aerator at a rate of 70 litres/min;
- An Easypump model 700A submersible irrigation pump.

10 November 1999	CofA AWTS 003	
Date of issue	**Certificate No**	**Manager Environmental Health Branch for Director-General (delegation PH335)**

This Certificate of Accreditation is in force until 31 December 2005.

Schedule 1: Conditions of Accreditation

1 For each installation the owner/occupier of a premises shall make an application to the Local Authority to install an Taylex Clearwater 90 compact AWTS as a waste management facility in accordance with Section 68, Part C of the Local Government Act 1993 and Clause 28 of the Local Government (Approvals) Regulation 1999.

2 The Certificate of Accreditation does not apply to the land application system used in conjunction with the AWTS.

3 The Taylex Clearwater 90 compact AWTS shall be supplied, constructed and installed in accordance with the design as submitted and accredited by the NSW Health Department.

4 Any modification or variations of such accreditation design of the Taylex Clearwater 90 compact AWTS shall be submitted for separate consideration and variation of accreditation by the Director-General of NSW Health.

5 Each Taylex Clearwater 90 compact AWTS shall be permanently and legibly marked on a non- corrosive metal plaque attached to the lid with the following information:

- The brand name of the system; and
- The manufacturer's name or registered trademark;
- The month and year of manufacture.

6 Effluent from the Taylex Clearwater 90 compact AWTS taken in any random grab sample shall comply with the following standard:

• BOD^5	less than 30 mg/L
• SS	less than 45 mg/L
• Free residual chlorine	greater than 0.2 and less than 2.0 mg/L
• Thermotolerant coliforms	less than 100 cfu/100 mL

7 The Local Authority shall require the owner/occupier of a premises to enter into an annual service contract with a service contractor or company acceptable to the Local Authority.

8 The Taylex Clearwater 90 compact AWTS shall be serviced at three monthly intervals in accordance with the details set out in the service manual.

9 At each anniversary of accreditation date the manufacturer shall provide a list of all their installed AWTS by anniversary year of installation to NSW Health. NSW Health will randomly select up to 5 (number) or 10% of the installed AWTS

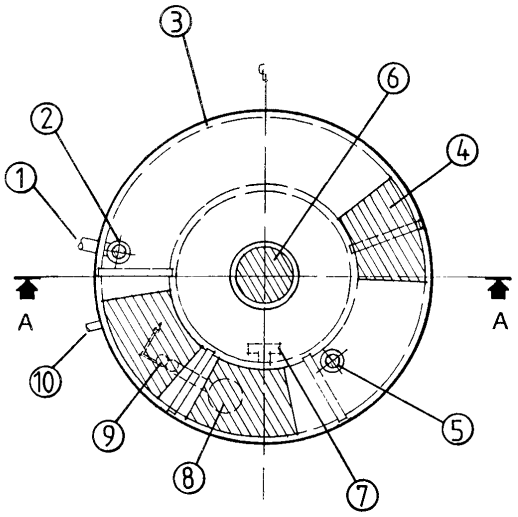
(which ever is the greater) from each year of installation. The manufacturer, at its own cost, shall arrange sampling of these locations to be performed within two months. Sampling is to be organised by an independent JAS/ANZ accredited agency. Samples for BOD5, SS, thermotolerant coliforms are to be determined by a NATA registered laboratory, and samples for disinfectant concentration, if appropriate, are to be determined on site. The results are to be reported to NSW Health by:

- address of premises,
- date sampled,
- sample identification number,
- BOD5,
- SS,
- thermotolerant coliforms,
- disinfectant concentration,
- service history, and
- graphs of accumulative data for BOD, SS, thermotolerant coliforms and disinfection concentration results for each anniversary group.

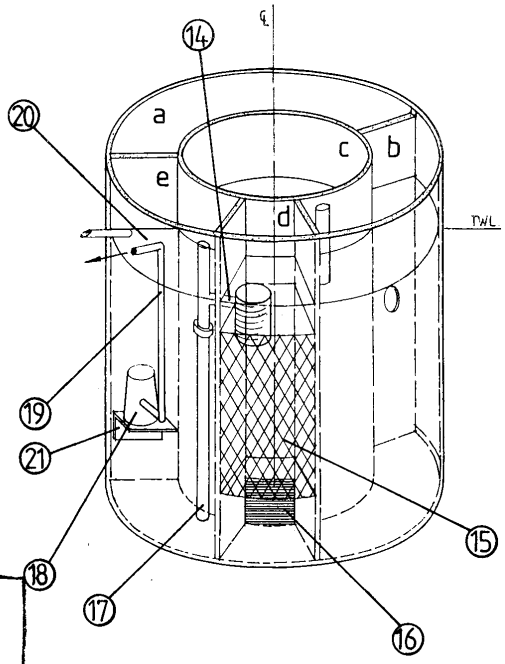
10 A copy of the following information shall be provided by the manufacturer to each local authority where it is intended to install AWTS in their area once Departmental accreditation has been obtained:

- Statement of warranty
- Statement of service life
- Quality Assurance Certification
- Installation Manual
- Service Manual
- Household Operators Manual
- Service Report Form
- Engineering Drawings on A3 format
- Detailed Specifications
- A4 Plans
- Accreditation documentation from NSW Health.

11 Product Approval to the StandardsMark Quality Assurance Program or equivalent (including accreditation to ISO 9000) shall be obtained within twelve months of the date of the certificate of accreditation.



TOP VIEW

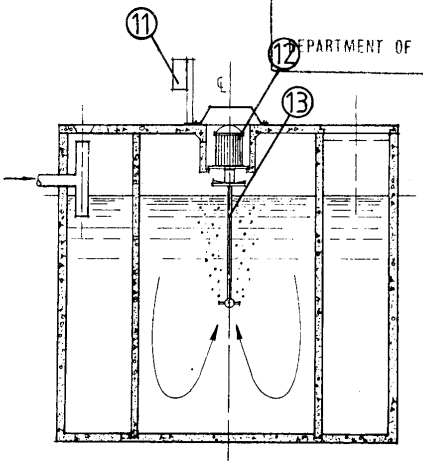


ISOMETRIC VIEW
LID REMOVED

a. PRIMARY PRE-TREATMENT CHAMBER
b. SECONDARY PRE-TREATMENT CHAMBER
a + b = 2886 LTR.
c. AERATION CHAMBER - 2367 LTR.
d. CLARIFIER - 757 LTR.
e. CHLORINATOR/PUMPWELL - 710 LTR.

TOTAL UNIT CAPACITY - 6720 LTR.
TOTAL VOLUME OF SYSTEM - 9100 LTR.

APPROVED
1 0 NOV 1999
DEPARTMENT OF HEALTH, N.S.W.



SECTION A-A

Certified as inspected & modified
W.S.S. Engineer
Beaudesert Shire Council
M. Hodge MIE (Aust) C.P. Engineer 200459

LEGEND

1. INLET 100 DIA. SEWER TO A.S. 3500.
2. PRECAST CONCRETE INLET PEEP TO A.S./N.Z. 1546/1998.
3. PRECAST CONCRETE TANK TO A.S./N.Z. 1546/1998.
4. PRECAST CONCRETE ACCESS LIDS (3 OFF) TO A.S./N.Z. 1546/1998.
5. PRECAST CONCRETE TRANSFER PEEP TO A.S./N.Z. 1546/1998.
6. PRECAST CONCRETE AERATOR LID TO A.S./N.Z. 1546/1998.
7. 100MM SEWER GRADE TEE/SURFACE SKIMMER.
8. ZABEL A100 FILTER.
9. TAYLEX MOULDED POLYPROPELENE CHLORINATOR.
10. 50MM S.W.V. EMERGENCY OVERFLOW.
11. TAYLEX ELECTRONIC CONTROL PANEL WITH PRINTED CIRCUIT.
12. C.M.G./TAYLEX AERATOR MOTOR.
13. STAINLESS STEEL SHAFT WITH FOAM RESTRICTOR AND ASPIRATOR.
14. 100MM DIA. SEWER TRANSFER PIPE.
15. FOOD GRADE P.V.C. BIOMASS PANELS.
16. STAINLESS STEEL SLUDGE RETURN VORTEX PLATE.
17. CHLORINE MIXING AND RETENTION 100 DIA. SEWER P.V.C.
18. EASYPUMP SUB 700A WITH AUTO FLOAT OPERATION.
19. 32MM DIA.PRESSURE P.V.C. WITH UNION.
20. 32MM IRRIGATION OUTLET SOCKET.
21. STAINLESS STEEL (316) SUPPORT BRACKET.

TITLE
TAYLEX CLEARWATER 90 COMPACT
HOME SEWAGE TREATMENT SYSTEM
10 PERSON 6720 LTR.

CLIENT
TAYLEX CLEARWATER 90 PTY.LTD.
14 ACTIVITY CRESCENT ERNEST, QLD. 4214 PH. 0755 715 122

DRAWN
ALAYNE WILLIAMS PH. 0413 317 690
QBSA. GOLD LICENCE NO. 065 843

DATE FEBRUARY 1999
AMENDED NOV '99

Appendix 2

Water and Nutrient Balance

197 Main Road Cardiff NSW 2285 Australia Telephone + 61 2 4954 4996
Email mail@whiteheadenvironmental.com.au Website www.whiteheadenvironmental.com.au

Irrigation Area Water Balance & Storage Calculations

Whitehead & Associates
Environmental Consultants

Site Address: **271 Powderworks Road, Ingleside**

INPUT DATA

Design Wastewater Flow	Q	800	L/day	
Design Irrigation Rate	DIR	3.5	mm/day	Litres/m^2/day - based on Table M1 AS/NZS 1547:2012 for secondary effluent
Available Land Application Area	L	270	m^2	Used for iterative purposes to determine storage requirements for nominated areas
Crop Factor	C	0.5-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type
Runoff Coefficient	RC	0.85	unitless	Proportion of rainfall that remains onsite and infiltrates; function of slope/cover, allowing for any runoff
Rainfall Data	Terrey Hills AWS 066059 - Median			Median Monthly data (16 years)
Evaporation Data	Sydney Observatory Hill 066062 - Mean			Mean Daily data (11 years)

Soil Category (AS1547:2012)	DIR	Units
Gravels and Sands (1)	5	mm/day
Sandy Loams (2)	5	mm/day
Loams (3)	4	mm/day
Clay Loams (4)	3.5	mm/day
Light Clays (5)	3	mm/day
Medium to Heavy Clays (6)	2	mm/day

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Days in Month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	31	28	31	30	31	30	**546**
Rainfall	R		mm/month	71.4	114.4	128.6	70.6	27.6	116.9	52.9	40.8	46.4	61.0	75.6	74.6	71.4	114.4	128.6	70.6	27.6	116.9	**880.8**
Evaporation			mm/day	4.6	3.9	3.1	2.6	1.9	1.2	1.5	1.9	2.5	3.3	4.3	4.4							
Evaporation	E		mm/month	142.6	109.2	96.1	78.0	58.9	36.0	46.5	58.9	75.0	102.3	129.0	136.4	142.6	109.2	96.1	78.0	58.9	36.0	**1068.9**
Crop Factor	C			0.80	0.80	0.70	0.70	0.50	0.50	0.60	0.60	0.70	0.70	0.80	0.80	0.80	0.80	0.70	0.70	0.50	0.50	
OUTPUTS (LOSSES)																						
Evapotranspiration	ET	ExC	mm/month	114.1	87.4	67.3	54.6	29.5	18.0	27.9	35.3	52.5	71.6	103.2	109.1	114.1	87.4	67.3	54.6	29.5	18.0	**770.43**
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	108.5	98.0	108.5	105.0	108.5	105.0	**1277.5**
Outputs		ET+B	mm/month	222.6	185.36	175.8	159.6	138.0	123.0	136.4	143.8	157.5	180.1	208.2	217.6	222.6	185.36	175.8	159.6	138.0	123.0	**2047.9**
INPUTS (GAINS)																						
Retained Rainfall	RR	RxRC	mm/month	60.69	97.24	109.31	60.01	23.46	99.365	44.965	34.68	39.44	51.85	64.26	63.41	60.69	97.24	109.31	60.01	23.46	99.365	**748.68**
Effluent Irrigation	W	(QxD)/L	mm/month	91.9	83.0	91.9	88.9	91.9	88.9	91.9	91.9	88.9	91.9	88.9	91.9	91.9	83.0	91.9	88.9	91.9	88.9	**1081.5**
Inputs		RR+W	mm/month	152.5	180.2	201.2	148.9	115.3	188.3	136.8	126.5	128.3	143.7	153.1	155.3	152.5	180.2	201.2	148.9	115.3	188.3	**1830.2**
STORAGE CALCULATION (Δ)																						
Storage Remaining from Previous Month			mm/month	0.0	0.0	0.0	25.4	14.7	0.0	65.3	65.7	48.4	19.2	0.0	0.0	0.0	0.0	0.0	25.4	14.7	0.0	
Storage for the Month	S	(RR+W)-(ET+B)	mm/month	-70.0	-5.2	25.4	-10.7	-22.6	65.3	0.4	-17.3	-29.2	-36.4	-55.1	-62.4	-70.0	-5.2	25.4	-10.7	-22.6	65.3	
Cumulative Storage	M		mm	0.0	0.0	25.4	14.7	0.0	65.3	65.7	48.4	19.2	0.0	0.0	0.0	0.0	0.0	25.4	14.7	0.0	65.3	
Maximum Storage for Nominated Area	N		mm	**65.7**																		
Storage Volume required	V	(NxL)/1000	m^3	**17.7**																		
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	153	254	373	241	217	1015	271	227	203	193	167	161	153	254	373	241	217	1015	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: **1,015** m^2

This value is based on the worst month of the year, so the balance overestimates the area/storage requirements and is therefore conservative for all other months

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Nutrient Balance

Whitehead & Associates
Environmental Consultants

Site Address: 271 Powderworks Road, Ingleside

Please read the attached notes before using this spreadsheet.

SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON THE MOST LIMITING BALANCE = 538 m^2

INPUT DATA [1]

Wastewater Loading			Nutrient Crop Uptake					
Hydraulic Load	800	L/day	Crop N Uptake	200	kg/ha/yr	which equals	54.79	$mg/m^2/day$
Effluent N Concentration	30	mg/L	Crop P Uptake	20	kg/ha/yr	which equals	5.48	$mg/m^2/day$
% Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal	**Phosphorus Sorption**					
Total N Loss to Soil	4,800	mg/day	P-sorption result	400	mg/kg	which equals	5,600	kg/ha
Remaining N Load after soil loss	19,200	mg/day	Bulk Density	1.4	g/cm^3			
Effluent P Concentration	14	mg/L	Depth of Soil	1	m			
Design Life of System	50	yrs	% of Predicted P-sorp. [2]	0.5	Decimal			

METHOD 1: NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer			Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)		
Nitrogen	350	m^2	Nominated LAA Size	1,015	m^2
Phosphorus	538	m^2	Predicted N Export from LAA	-13.29	kg/year
			Predicted P Export from LAA	-3.63	kg/year
			Phosphorus Longevity for LAA	138	Years
			Minimum Buffer Required for excess nutrient	0	m^2

PHOSPHORUS BALANCE

STEP 1: Using the nominated LAA Size

Nominated LAA Size	1,015	m^2				
Daily P Load	0.0112	kg/day	→ Phosphorus generated over life of system		204.4	kg
Daily Uptake	0.0055616	kg/day	→ Phosphorus vegetative uptake for life of system		0.100	kg/m^2
Measured p-sorption capacity	0.56	kg/m^2				
Assumed p-sorption capacity	0.280	kg/m^2	→ Phosphorus adsorbed in 50 years		0.280	kg/m^2
Site P-sorption capacity	284.20	kg	→ Desired Annual P Application Rate		7.714	kg/year
				which equals	0.02113	kg/day
P-load to be sorbed	2.06	kg/year				

NOTES

[1]. Model sensitivity to input parameters will affect the accuracy of the result obtained. Where possible site specific data should be used. Otherwise data should be obtained from a reliable source such as,

- *Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households*
- *Appropriate Peer Reviewed Papers*
- *EPA Guidelines for Effluent Irrigation*
- *USEPA Onsite Systems Manual.*

[2]. A multiplier, normally between 0.25 and 0.75, is used to estimate actual P-sorption under field conditions which is assumed to be less than laboratory estimates.

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Irrigation Area Water Balance & Storage Calculations

Whitehead & Associates
Environmental Consultants

Site Address: 271 Powderworks Road, Ingleside

INPUT DATA

Design Wastewater Flow	Q	800	L/day	
Design Irrigation Rate	DIR	3.5	mm/day	Litres/m^2/day - based on Table M1 AS/NZS 1547:2012 for secondary effluent
Available Land Application Area	L	540	m^2	Used for iterative purposes to determine storage requirements for nominated areas
Crop Factor	C	0.5-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type
Runoff Coefficient	RC	0.85	unitless	Proportion of rainfall that remains onsite and infiltrates; function of slope/cover, allowing for any runoff
Rainfall Data	Terrey Hills AWS 066059 - Median			Median Monthly data (16 years)
Evaporation Data	Sydney Observatory Hill 066062 - Mean			Mean Daily data (11 years)

Soil Category (AS1547:2012)	DIR	Units
Gravels and Sands (1)	5	mm/day
Sandy Loams (2)	5	mm/day
Loams (3)	4	mm/day
Clay Loams (4)	3.5	mm/day
Light Clays (5)	3	mm/day
Medium to Heavy Clays (6)	2	mm/day

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Days in Month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	31	28	31	30	31	30	**546**
Rainfall	R		mm/month	71.4	114.4	128.6	70.6	27.6	116.9	52.9	40.8	46.4	61.0	75.6	74.6	71.4	114.4	128.6	70.6	27.6	116.9	**880.8**
Evaporation			mm/day	4.6	3.9	3.1	2.6	1.9	1.2	1.5	1.9	2.5	3.3	4.3	4.4							
Evaporation	E		mm/month	142.6	109.2	96.1	78.0	58.9	36.0	46.5	58.9	75.0	102.3	129.0	136.4	142.6	109.2	96.1	78.0	58.9	36.0	**1068.9**
Crop Factor	C			0.80	0.80	0.70	0.70	0.50	0.50	0.60	0.60	0.70	0.70	0.80	0.80	0.80	0.80	0.70	0.70	0.50	0.50	
OUTPUTS (LOSSES)																						
Evapotranspiration	ET	ExC	mm/month	114.1	87.4	67.3	54.6	29.5	18.0	27.9	35.3	52.5	71.6	103.2	109.1	114.1	87.4	67.3	54.6	29.5	18.0	**770.43**
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	108.5	98.0	108.5	105.0	108.5	105.0	**1277.5**
Outputs		ET+B	mm/month	222.6	185.36	175.8	159.6	138.0	123.0	136.4	143.8	157.5	180.1	208.2	217.6	222.6	185.36	175.8	159.6	138.0	123.0	**2047.9**
INPUTS (GAINS)																						
Retained Rainfall	RR	RxRC	mm/month	60.69	97.24	109.31	60.01	23.46	99.365	44.965	34.68	39.44	51.85	64.26	63.41	60.69	97.24	109.31	60.01	23.46	99.365	**748.68**
Effluent Irrigation	W	(QxD)/L	mm/month	45.9	41.5	45.9	44.4	45.9	44.4	45.9	45.9	44.4	45.9	44.4	45.9	45.9	41.5	45.9	44.4	45.9	44.4	**540.7**
Inputs		RR+W	mm/month	106.6	138.7	155.2	104.5	69.4	143.8	90.9	80.6	83.9	97.8	108.7	109.3	106.6	138.7	155.2	104.5	69.4	143.8	**1289.4**
STORAGE CALCULATION (Δ)																						
Storage Remaining from Previous Month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the Month	S	(RR+W)-(ET+B)	mm/month	-116.0	-46.6	-20.5	-55.1	-68.6	20.8	-45.5	-63.2	-73.6	-82.3	-99.5	-108.3	-116.0	-46.6	-20.5	-55.1	-68.6	20.8	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.8	
Maximum Storage for Nominated Area	N		mm	**20.8**																		
Storage Volume required	V	(NxL)/1000	m^3	**11.2**																		
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	153	254	373	241	217	1015	271	227	203	193	167	161	153	254	373	241	217	1015	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: **1,015** m^2 This value is based on the worst month of the year, so the balance overestimates the area/storage requirements and is therefore conservative for all other months

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Site Address: 271 Powderworks Road, Ingleside

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Design Irrigation Rate	DIR	3.5	mm/day	Litres/m^2/day - based on Table M1 AS/NZS 1547:2012 for secondary effluent
Available Land Application Area	L	1,015	m^2	Used for iterative purposes to determine storage requirements for nominated areas
Crop Factor	C	0.5-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type
Runoff Coefficient	RC	0.85	unitless	Proportion of rainfall that remains onsite and infiltrates; function of slope/cover, allowing for any runoff
Rainfall Data	Terrey Hills AWS 066059 - Median			Median Monthly data (16 years)
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Soil Category (AS1547:2012)	DIR	Units
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Loams (3)	4	mm/day
Clay Loams (4)	3.5	mm/day
Light Clays (5)	3	mm/day
Medium to Heavy Clays (6)	2	mm/day

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Days in Month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	31	28	31	30	31	30	**546**
Rainfall	R		mm/month	71.4	114.4	128.6	70.6	27.6	116.9	52.9	40.8	46.4	61.0	75.6	74.6	71.4	114.4	128.6	70.6	27.6	116.9	**880.8**
Evaporation			mm/day	4.6	3.9	3.1	2.6	1.9	1.2	1.5	1.9	2.5	3.3	4.3	4.4							
Evaporation	E		mm/month	142.6	109.2	96.1	78.0	58.9	36.0	46.5	58.9	75.0	102.3	129.0	136.4	142.6	109.2	96.1	78.0	58.9	36.0	**1068.9**
Crop Factor	C			0.80	0.80	0.70	0.70	0.50	0.50	0.60	0.60	0.70	0.70	0.80	0.80	0.80	0.80	0.70	0.70	0.50	0.50	
OUTPUTS (LOSSES)																						
Evapotranspiration	ET	ExC	mm/month	114.1	87.4	67.3	54.6	29.5	18.0	27.9	35.3	52.5	71.6	103.2	109.1	114.1	87.4	67.3	54.6	29.5	18.0	**770.43**
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	108.5	98.0	108.5	105.0	108.5	105.0	**1277.5**
Outputs		ET+B	mm/month	222.6	185.36	175.8	159.6	138.0	123.0	136.4	143.8	157.5	180.1	208.2	217.6	222.6	185.36	175.8	159.6	138.0	123.0	**2047.9**
INPUTS (GAINS)																						
Retained Rainfall	RR	RxRC	mm/month	60.69	97.24	109.31	60.01	23.46	99.365	44.965	34.68	39.44	51.85	64.26	63.41	60.69	97.24	109.31	60.01	23.46	99.365	**748.68**
Effluent Irrigation	W	(QxD)/L	mm/month	24.4	22.1	24.4	23.6	24.4	23.6	24.4	24.4	23.6	24.4	23.6	24.4	24.4	22.1	24.4	23.6	24.4	23.6	**287.7**
Inputs		RR+W	mm/month	85.1	119.3	133.7	83.7	47.9	123.0	69.4	59.1	63.1	76.3	87.9	87.8	85.1	119.3	133.7	83.7	47.9	123.0	**1036.4**
STORAGE CALCULATION (Δ)																						
Storage Remaining from Previous Month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the Month	S	(RR+W)-(ET+B)	mm/month	-137.5	-66.1	-42.0	-75.9	-90.1	0.0	-67.0	-84.7	-94.4	-103.8	-120.3	-129.8	-137.5	-66.1	-42.0	-75.9	-90.1	0.0	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.0																		
Storage Volume required	V	(NxL)/1000	m^3	0.0																		
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	153	254	373	241	217	1015	271	227	203	193	167	161	153	254	373	241	217	1015	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 1,015 m^2 This value is based on the worst month of the year, so the balance overestimates the area/storage requirements and is therefore conservative for all other months

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