APPENDIX D

Effluent Management Report

PACIFIC ENVIRONMENTAL
ABN 84 161893223
Contaminated Land Consultants, Water, Wastewater & Environmental Engineers

PROPOSED ON-SITE SEWAGE TREATMENT FACILITIES & EFFLUENT RE-USE SCHEME

AT
SCHOTTLANDERS WAGYU ABATTOIR & RESTAURANT
96 ROSE VALLEY ROAD
ROSE VALLEY NSW

FOR

ENDO TECHNIK-NORD PTY LTD

PREPARED BY
Pacific Environmental Services Pty Ltd
PO Box 4045,
Illawong NSW 2234
Phone : 9543 2825
Fax: 9543 2823
Email: decontam@bigpond.net .au
DATE :16th January 2015
REFERENCE:
EffluentDisposal/EndotechnikRoseValleySTP19thJune2015C

TABLE OF CONTENTS

STATEMENT

This report has been prepared on the basis of a site inspection on Wednesday 18th October 2013 and the visual observations made at that time as well as the soil sample test results from a soil sampling program undertaken on that date. The report also relies upon the description of the proposed abattoir supplied by Endo Technik-Nord Pty Ltd (the client) as well as a description of the proposed restaurant. The test results of four (4) soil samples from the proposed irrigation area are also relied upon. The effluent flow rate data has been assessed from data supplied by the client and an assessment by Pacific Environmental of that data. The reports accuracy and findings are based on the above information only. This report has been prepared by an experienced sewage treatment plant design engineer.

Stephen John Smith
Bsc. Eng., MEng. Sc., CPEng
Director Pacific Environmental
16th January 2014

project as proscribed by the Trade Practices legislation that is current at the time of publishing this document.

Date	Issued to	Revision
16 January 2015	Endo Technik-Nord Pty Ltd	0
19th June 2015	Endo Technik-Nord Pty Ltd	1- Updated reference to AS/NZS 1547:2012

SECTION 1.0 - INTRODUCTION

Endo Technik-Nord Pty Ltd has briefed Pacific Environmental (PE) to undertake the following investigation:

- The soil and land area requirements for the disposal of treated effluent from the proposed abattoir and sixty (60) seat restaurant. The abattoir will have a capacity of 2 cows per week and staff toilet facilities (the land immediately adjacent to the abattoir site will be utilized for effluent irrigation);
- Prepare a process design for the treatment of raw effluent with respect to providing facilities for the abattoir and restaurant.

The site is located at 96 Rose Valley Road Rose Valley, NSW and the proposed surface irrigation area is located immediately east of the internal road adjoining the proposed abattoir. The restaurant is proposed to be located nominally 200 m north east of the existing residence and 350 m northwest of the abattoir. The property and the irrigation area are detailed at ***Appendix A – SITE PLAN.*** An activated sludge, fixed film, intermittent aerated, continuous extended aeration treatment plant proposed, with suitable and routine maintenance and is adequate for the proposed organic and hydraulic load to be placed upon it. Adequate flow balancing at the upstream end of the STP will aid in bacteria and hydraulic treatment viability. The proposed abattoir and latrine facilities (within the abattoir) will generate a maximum of 400 L litres per day, post a grease trap of 1,000L. The organic load from the abattoir is 1,800 mg/L (reference NSW PWD historical data) or 720 grams per day of BOD. The restaurant is predicted to generate 5,400 grams of BOD per day, three (3) days per week and 2,700 grams of BOD per day three (3) days per week.

The restaurant will discharge kitchen waste to a 5,000 L grease trap then to a common line from the toilet facilities to the STP. The STP will have flow balancing, prior to the primary tank of 4,000 L, will ensure that the STP receives a balanced daily load, with an additional 7,000 L of wet weather storage.

The restaurant is predicted to generate a waste flow of 2,400L three (3) days per week and 1,200 L three (3) days per week (one (1) day closed). After flow balancing the STP will see 2,200 L per day (seven days per week) from the restaurant and the abattoir (being 400 L per day over seven (7) week days). The combined waste flow is predicted to be 2,200 L per day, with a combined BOD of 1,877 grams per day. The treated effluent, is proposed to be surface irrigated over and a new irrigation area of 2,200 m^2 at 1.0 mm/day depth. This size of irrigation area has been chosen after undertaking a water balance calculation involving the Meteorological Bureau rainfall and evaporation records. This land has sufficient buffer zones to meet the Industry standard requirements for set backs to boundaries and water courses. The property and the irrigation area are detailed at ***Appendix A – SITE PLAN***. The proposed irrigation area is marked at this plan. The sewage treatment facilities (STP) are proposed to be designed on the basis of:

- Flow rate allowed at 2,200 litres per day (after flow balancing);
- Organic load 1.877 grams per day of BOD;
- Flow balancing of 4,000 litres (plus 7,000 L of wet weather storage).

.

A schematic of the STP is provided at ***Appendix B - STP SCHEMATIC***.

The design, laid out in this report is based upon the requirements of the available Guidelines being:

- *Environmental & Health Protection Guidelines On – Site Sewage Management of Single Households* – February 1998;
- *AS/NZS 1547:2012 – " On-Site Domestic-Wastewater Management*";
- *"Environmental Guideline Use of Effluent by Irrigation"* – Dept of Environment and Conversation (NSW) December 2004;
- *Design Guide for the Disposal of Wastewaters by Land Application NSW SPCC.*

The NSW EPA (formerly DECCW) document provides a more updated Guideline, although incomplete with respect to buffer zones. The AS/NZS provides some assistance with respect to buffer zones. However the assistance results in a wide range of buffer zones dependent upon effluent quality and the level of tertiary treatment provided. This leaves leaving the 1998 document as the most appropriated guide.

This report examines and reports upon the following:

- The suitability of the soils and the land immediately east of the abattoir and access road (10,500 m^2).
- The size of the proposed sewage treatment plant to meet the needs of the proposed abattoir and latrine facilities.

The investigation concludes that the proposed irrigation site soils are suitable, after the addition of lime and gypsum, for the continued irrigation of secondary treated effluent. Above ground irrigation is sustainable, due to the buffer zones available to the proximity of public access areas. It is on this basis that the water balance calculations have been undertaken. The area proposed for the secondary treated effluent disposal is shown at ***Appendix A*** and occupies 10,500 m^2.

A hydraulic water balance calculation has been undertaken to check that sufficient land has been set aside for effluent disposal from the proposed abattoir and ascertain if a wet weather storage is required. An average daily discharge rate (10,500 litres per day after flow balancing) has been utilized for calculation purposes. No wet weather storage is theoretically required. The calculations take into account secondary treated wastes produced by the proposed sewage treatment plant. These calculations demonstrate the capability of the proposed system to store and treat the produced effluent even under adverse wet weather conditions. This aspect is further detailed at Section 4.4 of this report.

A nutrient balance calculation has been undertaken at Section 6.0 and this demonstrates that the limitation on effluent disposal is hydraulic flow. The water balance indicates that a raw waste primary treatment /storage tank of 20,000 L is more than that required. The water balance calculations are contained at ***Appendix D- WATER BALANCE.*** The additional storage installed would be available to be utilized in periods of extended wet weather

The site investigation is based upon the soil analysis findings detailed at ***Appendix B - SOIL ANALYSIS***.

The investigation found that the soils at the site have a limitation for on-site sub-soil irrigation disposal of treated effluent system on the basis of:

- Soil pH.
- Cation Exchange Capacity.

The proximity of the area site access roads, domestic dwellings and the property boundaries brings into account the requirement for buffer irrigation distances, which will be 3 m to the up-gradient boundary to the driveway. All the other buffer zone requirements for buffer zones have been met.

The irrigation areas are not crossed by the internal roads and hence no traffic will traverse the area.

The site soils identification and their physical classification relies upon the site inspection by Pacific Environmental and the laboratory analysis by Southern Cross University(a QA Certified Laboratory Registered Number CLP0052) as reported at ***Appendix B – SOIL ANALYSIS.***

Section 4 of this report, details the Soil Assessment Ratings in the format of Table 6 Health Protection Guidelines February 1998 – Soil Assessment Parameters of the Environment and discusses those results.

Each soil sample collected has been tested in accordance with the guidelines set out in Table 6- Soil Assessment Rating for On Site Systems of the Publication "Environmental & Health Protection Guidelines On – Site Sewage Management of Single Households."- This report also refers to AS/NZS 1547:2012 – "On-Site Domestic-Wastewater Management". Whilst neither document is written for commercial applications the tight restrictions contained therein are the most suitable guidelines available in NSW.

Cattle will need to be kept of the irrigation area for at least thirty days following irrigation with treated effluent.

SECTION 2.0 -SOIL TEST CORE HOLES

There were three (3) sample core holes dug and four (4) samples taken in the investigation area. This area is identified as the land shown at ***Appendix A***, the proposed irrigation site. Two (2) Test bores were taken to 500 mm to select a sample of the strata immediately under the top soil for test; the third bore was to be taken to 1500mm to ensure that the depth of available soil was greater than 1.0 m; this latter bore was sampled at 0.3 m and 1.0 m BGL. Rock was not encountered in any of the holes. Each hole was mechanically augured utilizing an 85 mm diameter bit. The auger was cleaned after each hole to prevent cross-contamination. All holes were augured in the area visually suitable for an effluent disposal system and inside the area delineated by the boundaries detailed at ***Appendix A***. The site soils were found to be uniform. The holes were selected from a cross section of the site, to be in accordance with the number of tests required by the Environmental & Health Protection Guidelines. This approach is also acceptable when the site soils are to be viewed as a mass for disposal purposes. All areas exhibited soils physical characteristics in profile that were similar clay loam, with increasing clay at depth.

SECTION 3.0 – DISCUSSION OF LABORATORY RESULTS

3.1 - INTRODUCTION

The Soil Test Reporting, including chemical analysis attached at ***Appendix B – SOIL ANALYSIS,*** cover the following parameters:

1. Soil permeability;
2. Coarse fragments;
3. Bulk density;
4. PH;
5. Electrical conductivity;
6. Sodicity;
7. Cation exchange capacity;
8. Phosphorus sorption;
9. Modified Emersion Aggregate Test.

The following were assessed on site:

1. Depth to bedrock.
2. Depth to high episodic/seasonal watertable.

Each of these parameters is discussed in the following sections and assessed against the "Environment & Health Protection Guidelines – On-Site Sewage Management for Single Households – February 1998". This Guideline has been adopted by Local Government for inclusion in DCPs for larger wastewater irrigation schemes.

3.2 – DEPTH TO BEDROCK

One auger test pit hole was taken to a 1500mm depth to check for rock, no rock was encountered. A visual check of the whole effluent area revealed no rock outcrops. Neighboring anecdotal evidence suggests that rock would be encountered at depths greater than 4m depth. The lack of rock in the soil profile in excess of 1.0m indicates that this parameter is not a limiting factor in sizing the effluent/reuse area.

3.3 – DEPTH TO WATERTABLE

One auger test pit hole was taken to a 1500mm. At this depth no perched water table was encountered. The unnamed water course (108 m east of the site) suggests that the permanent water table is located at depths greater than 5 m. The location of the water table is not a constraint on any effluent disposal systems.

3.4 – SOIL PERMEABILITY

The site soils under the clay loam topsoil (0 – 200mm) are uniformly clay (300 – 1500). A thin layer of humus is present over parts of the site that support non-native grasses and minor tree growth.

The site chosen for the proposed disposal/reuse system is considered to be poorly drained, with a soil design irrigation permeability of 15mm/week for the medium to heavy clays (ref.: AS/NZS 1547: 2012 TABLE 4.2A4) – the design application rate is 7 mm/week, or 1 mm/day (which is less than the permeability acceptance rate).

The majority of the proposed site is thus classified as having a Permeability Category of 6b – moderately pedal. As such it has the appearance of having a major limitation to -surface disposal. The selection of an irrigation rate of less than 15mm/week will alleviate this limitation. Thus the provided 2,200 m^2 will be more than sufficient to irrigate a maximum of 2,200 L per day of treated effluent.

The design irrigation rate (DIR) from Table 4.2A4 of AS/NZS 1547:2012 is dependent upon the surface and immediate sub surface and is:

- Medium to heavy clay 15mm/ week.
- The chosen application rate – **7.0 mm/week.**

3.5 - COARSE FRAGMENTS

The coarse fragments found on the site during the investigation are uniformly 3% comprising pebbles or gravel. These coarse fragment percentages allow the use of land applications systems that involve trenches or surface irrigation of treated effluent.

3.6 – BULK DENSITY

The bulk density of the site soil is 1.38 g/cm ^{3}. This represents a minor limitation to surface or sub – surface irrigation systems.

3.7 – PH

The pH of the soils that were sampled from the auger holes was consistently between 5.09 and 5.11. This represents a moderate limitation to plant growth for surface irrigation, absorption trench, pressure injection or transpiration mounds systems that do not utilize high pH media. It is recommended to utilize lime to assist in raising the soil pH. The recommended lime addition is 3kg/m^3 to the soil to a depth of 0.30 m.

3.8 – ELECTRICAL CONDUCTIVITY

The electrical conductivity, measured as dS/cm of the soil samples was 0.995 and 1.180. This result indicates no limitation to plant growth and thus has no consequences on the type of disposal required.

3.9 – SODICITY

The level of exchangeable sodium cations in the soil limits the infiltration capacity of the hydraulic activity. The samples tested exhibited an average sodicity of 4.5%. This represents a major limitation to site surface irrigation or absorption. The addition of lime enhances the soils capacity to deal with exchangeable sodium in the wastewater, as discussed at Section 3.7, thus resolving the problem of exchangeable sodium percentage.

3.10 – CATION EXCHANGE CAPACITY

The cation exchange capacity of the site soil samples is moderately unbalanced. The measured exchange capacity average is 8.58 $cmol^{+}$ /Kg and as such is regarded as a moderate limitation to surface and unmodified soil absorption.

The cation exchange capacity of the soil in the irrigation area is to be raised by the addition of lime.

3.11 - PHOSPHORUS SORPTION

The average Phosphorus Retention Index was measured at 9.6 or 14.4t. This represents a minor limitation or restriction for effluent disposal by surface irrigation without phosphorus removal from the effluent.

The addition of lime will improve the phosphorus sorption.

3.12 – MODIFIED EMERSON AGGREGATE TEST

The minor dispersive nature of the site soils clearly indicates that surface irrigation techniques or sub-surface site absorption are the best options, without reworking of the soils. Dispersive soils pose a major limitation to on-site sewerage management for storm event years. The maintenance of the non-native vegetative cover will ensure that there are no siltation or erosion problems.

SECTION 4.0 – SITE EVALUATION

The evaluation of the site physical parameters involves the following:

- **CLIMATE**: Extreme low temperatures are not anticipated, except in exceptional circumstances. The rainfall and evaporation data have been assessed using the Bureau of Meteorology mean data for Precipitation and evapotranspiration at Kiama Bowling Club Station. There is no aspect of the area climate that would prohibit site disposal systems.

- **FLOOD POTENTIAL**: The land in question is above the 1 in 100 year flood level and is regarded as not being flood prone due to its elevation.

- **EXPOSURE**: The site has good exposure to sun and wind, with an eastern exposure, close to a ridge line.

- **SLOPE**: The area chosen for the effluent treatment and disposal system has a moderate slope of between 3 and 4%.

- **LANDFORM**: The site located on the side of a small ridge west of the Princes Highway. There is an unnamed water course (108 m south of the site); hence the 100m and 40m buffer zone requirements are met. No marshy or wet ground is present.

- **RUN-ON AND SEEPAGE**: The site chosen has no seepage from higher ground.

- **EROSION POTENTIAL**: The site soils are not subject to erosion potential, except under circumstances of exposure and running water. This situation is not anticipated as part of the effluent handling process. The area is well grassed and the grass cover will be maintained in the irrigation area.

- **SITE DRAINAGE**: The site primarily drains initially to the east thence to the south east. There are no buildings to add roof water to the drainage system. The site soils are mildly self draining and ponding is not anticipated to occur.

- **FILL**: No site fill was encountered during the site inspection.

- **SURFACE ROCKS:** The area has no rock outcrops. The site chosen for the effluent disposal/reuse system has no rock outcrops.

- **BUFFER DISTANCES CRITICAL AREAS:**

  - Permanent Waters >500m (>/=100metres required);
  - Local waterways/ drains/creeks 108 m (>/=10metres required);
  - Boundary of site u/gradient >/= 3m (>/=3metres required);
  - Boundary of site d/gradient >/=6m (>/=6metres required);
  - Swimming Pools etc NA;
  - Site dams NA (</= 40metres required).
  - Internal roads 3m (3 m required up gradient)

The buffer zones recommended by the “Environment & Health Protection Guidelines – On-Site Sewage Management for Single Households – February 1998 – Table 5 have been met in the proposal. The buffer zones recommended by AS/NZS 1547:2012 are also met.

SECTION 5.0 - WATER BALANCE AND STORAGE

The water balance and storage calculations by Pacific Environmental have been undertaken and found to be applicable to the site meteorology and the applied hydraulic load. The results are that the irrigation area proposed and detailed in this report is appropriate. The water balance calculations are contained at ***Appendix C – WATER BALANCE CALCULATIONS***. The rainfall and evaporation data have been assessed using the Bureau of Meteorology data for Mean Precipitation and for Mean Evaporation from the Kiama Bowling Club Station.

The water balance indicates that no treated effluent will require storage during the wettest month in a 1 in 2 year rainfall, being February. However five (5) days storage will be installed to allow for wet days.

5.1 - EFFLUENT VOLUMES

The proposed abattoir, staff and restaurant will generates a maximum of 10,500 litres per day after flow balancing, prior to the primary tank of the STP; this will l ensure that the STP receives a balanced daily load of 2,200L/day. The treated waste flow (10,500 litres per day, after flow balancing), is proposed to be surface irrigated over and a new irrigation area of 2,200 m^2 at 1.0 mm /day depth. The sewage treatment facilities (STP) are proposed to be designed on the basis of:

- Restaurant 120 meals (2 per seat)at 20 L/meal three (3) days per week = 2,400 L per day;
- Restaurant 60 meals (0.5 per seat) at 20 L /meal three (3) days per week = 1,200 L per day;
- Abattoir 700 L per day, four (4) days per week.

The average flow rate over seven days (post flow balancing) is 1,943 L/day. Utilizing 2,200 L/day (to include a FOS of 12%) requires a flow balancing tank of 600 L. In order to take into account the diurnal variations that would have a peaking factor of 6 (2 x 2 hour peaks) a flow balance tank of 3,600 L is required. After the addition of a FOS of 10% a 4,000 L tank is to be provided.

5.2 WET WEATHER STORAGE

The water balance calculations indicate that at the design application rate there will be no requirement for wet weather storage; however up to 7,000 L will be available on site to allow for five (5) days of wet weather storage.

- **Storage recommended: 7,000 in addition to the 4,000 L in the balance tank giving 11,000 litres.**

5.3 DISPOSAL / REUSE AREA

The area proposed for the secondary treated effluent disposal is shown at ***Appendix A*** and occupies 2,200 m^2.

The recommended surface irrigation system should have the following characteristics:

- The irrigation lines should be placed at 90^0 to the land slope ie along the contour and as level as possible;
- The feed to the irrigation area should be from the bottom to the top;
- Horizontal spacing between the irrigation heads/spray should be nominally 3.3 m;
- The irrigation line should be fitted with a non-leakage system to prevent drainage when the supply pump is turned off;
- A supply line to the irrigation lines should be installed such that it acts as a header;
- The end of the irrigation lines should be fitted with a flush manifold and valve;
- Supply and flush manifolds should be a minimum of 25mm LDPE;

- A rain sensor is to be installed, to isolate the irrigation pumps after 4mm of rainfall and to keep the pumps isolated for 24 hours following rainfall cessation.

SECTION 6.0 NUTRIENT BALANCE

6.1 NITROGEN LOADING

Assuming that the nitrogen concentration in the abattoir raw effluent is 100 mg/L (based upon NSW PWD Trade Waste data) the denitrification in the STP will reduce this to 10mg/L, however assume 15mg/L as a FOS. The raw restaurant effluent will be 80 mg/L of nitrogen and the effluent, post treatment is assumed to be (worst case 15mg/L)

The minimum irrigation area is calculated thus:

Nitrogen concentration x flow rate divided by loading rate = (N mg/L x Q L/day) / 25 $mg/m^2/d$.

(15mg/L x 2,200 L/day) / $25mg/m^2/d$ = 1,320 m^2.

The minimum area is 1.320 m^2< than the selected 2,200 m^2.

6.2 PHOSPHORUS LOADING

The assessment of the irrigation area required is calculated by calculating the irrigation period required by the phosphorus loading.

The area required is calculated by: Area = $P_{generated}$ / ($P_{adsorption}$ + P_{uptake}). (equation 6.2)

The Phosphorus generated is the expected effluent concentration x volume of wastewater over 50 years:

The raw waste will have total Phosphorus load of 18 mg/L (NSW PWD) and a minimum of 30% will be removed in the waste sludge giving 12.6 mg/L in the effluent.

12.6 mg/L x 2,200 L/day x 50 x $365/10^6$ = 506 kg.

The phosphorus sorption capacity is calculated using the following parameters:

- P_S (400mg/kg)/2= critical capacity = 200mg/kg (before leaching occurs);
- Soil density = 1,380kg/m^3;
- Land Area for irrigation 2,200 m^2 (0.22 ha);
- Total P applied in effluent 12.6 mg/L;
- Volume of effluent at 2,200 L/day = 0.803 ML/a.

The P adsorbed before leaching = 200mg/kg x 1380 kg/m x 1m x 2,200 $m^2/10^6$ = 607.2 kg or 2,760 kg/ha or 0.276 kg/m^2

Total P in applied effluent per year: 12.8 mg/L x 2,200 L/d x $365/10^6$ = 10.278 kg/a

Total P removed by crop per ha per year = 60kg/ha/a (reference DECCW Guidelines for use of effluent by irrigation December 2004, Table 4.2). There fore the total P removed by the site non-native grasses per year over the irrigation area will be:

13.2 kg/a >> 10.278 kg/a.

The Site Irrigation Period is therefore is not a factor as the generating capacity. The land required is as per equation 6.2 above and is:

10.278/ (0.276 kg/m^2 +13.2 x 10^{-4}) = 37 m^2<< 2,200 m^2 supplied.

SECTION 7.0 SEWAGE TREATMENT PLANT

The proposed sewage treatment plant has been designed on the following basis (post flow balancing):

- Hydraulic load - 2,200 L/day;
- BOD - 1,877 grams per day

The proposed system is to comprise:

- Raw waste balance tank 4,000 L plus wet weather storage of 7,000 L = 11,000 L, with transfer pump of 1.74 L/min.
- Primary settlement and return sludge digestion Tank – 4,000 litres, with a transfer pump;
- Secondary aeration – 5,500 litres;
- Clarifier/settlement tank – 0.5 m diameter and 1.5 m waster depth (min);
- Secondary treated water irrigation tank – 1,200 litres and minimum 0.5m diameter;
- 400/min aerators, allowing for 18 hours aeration per day and air lift RAS;
- Aeration chamber fixed film media – 150 m^2.
- Disinfection although not required as the irrigation area is remote and has no public access, the proximity of flood prone land would make a sand filtration then UV disinfection prudent;
- Irrigation pumps – on demand.

SECTION 8.0 – SUMMARY

The site soil investigation confirmed that surface irrigation of secondary treated effluent is a viable effluent disposal option for the proposed abattoir. The surface irrigation system recommended is the above ground irrigators with 3.3m spray distance set along the western boundary of the irrigation area. The disposal will require a highly treated effluent in conjunction with an efficient distribution system. The site soils can be improved to accept the equivalent of secondary treated effluent after the addition of lime at a rate of 3kg/m^3; this will assist with the low pH and the mildly dispersive nature of the soils. After this treatment the soils will be suitable for the acceptance of neutral or slightly elevated pH effluent.

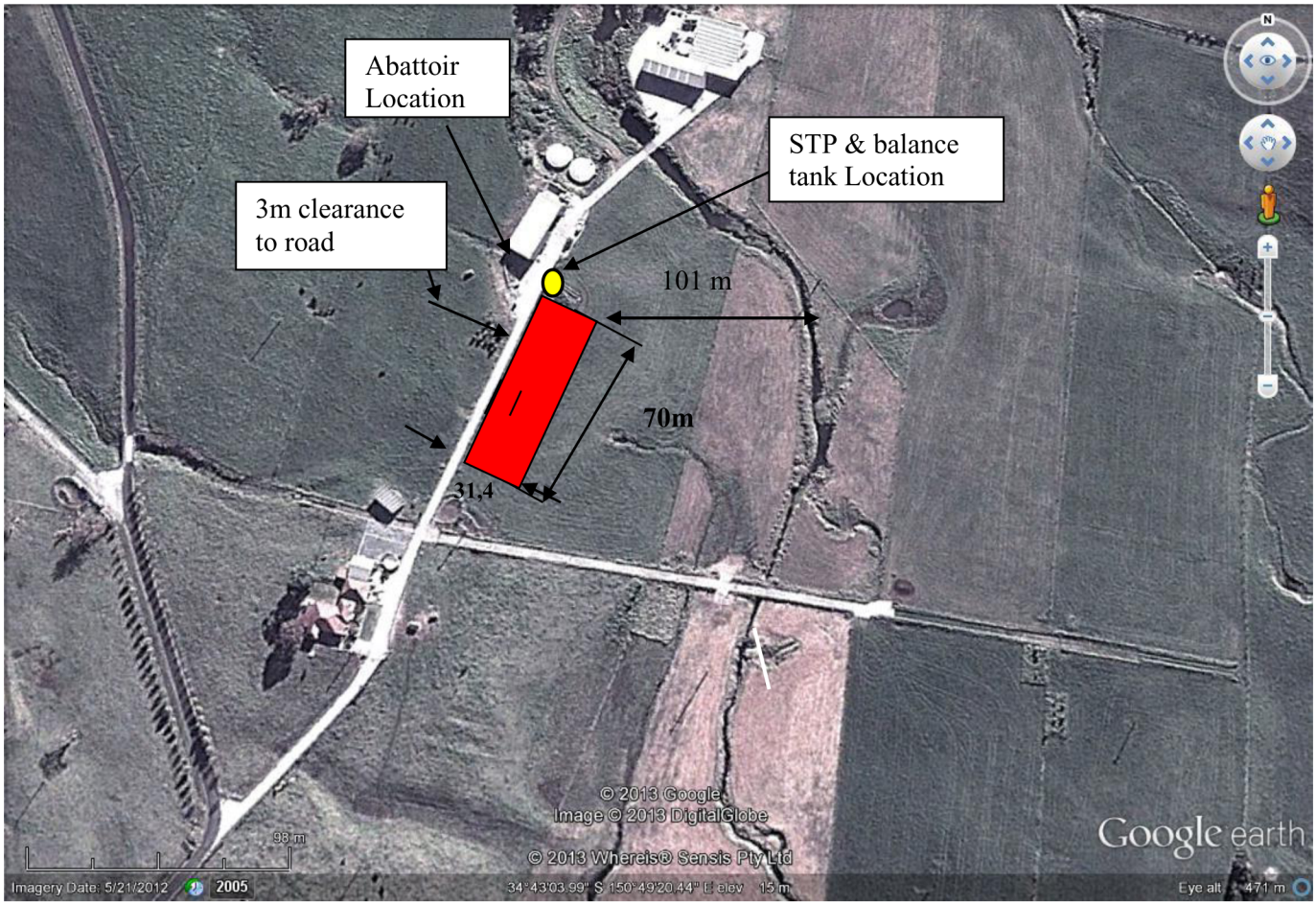
The lime addition should take place over 12 months by broad acre spreading on at least three (3) occasions to avoid burning of the site grasses.

During extended periods of high rainfall in March, it is envisaged that the wet weather storage system may reach capacity and require commercial pump out.

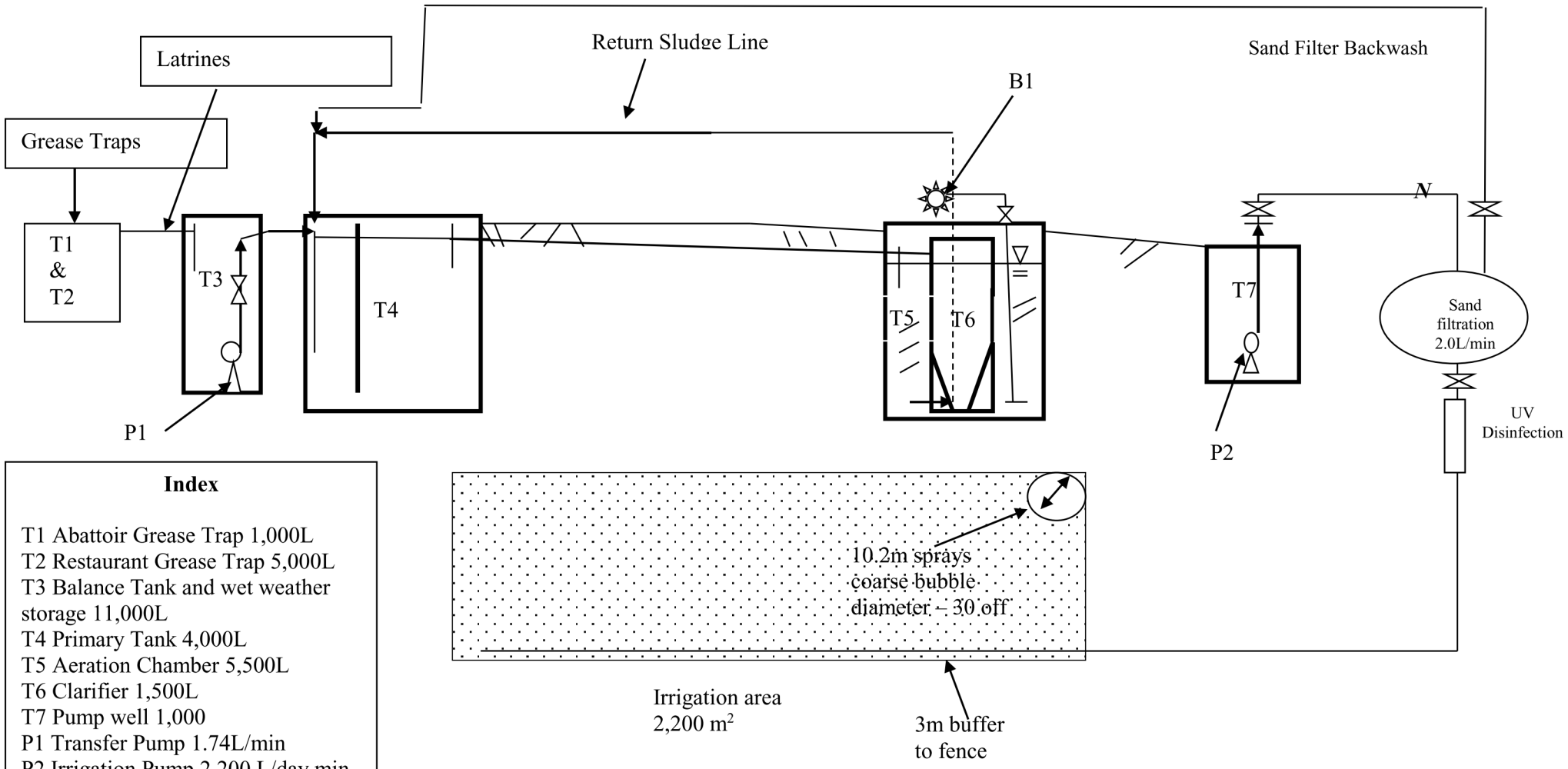
The recommendations to the sewage treatment plant (reference Section 6.0) be installed.

The recommended irrigation area is 2,200 m^2.

APPENDIX A – SITE PLAN



APPENDIX B STP SCHEMATIC



Index

T1 Abattoir Grease Trap 1,000L
T2 Restaurant Grease Trap 5,000L
T3 Balance Tank and wet weather storage 11,000L
T4 Primary Tank 4,000L
T5 Aeration Chamber 5,500L
T6 Clarifier 1,500L
T7 Pump well 1,000
P1 Transfer Pump 1.74L/min
P2 Irrigation Pump 2,200 L/day min

APPENDIX C – SOIL ANALYSIS

SEPTIC DISPOSAL ASSESSMENT (page 1 of 1)

4 soil samples from Pacific Environmental supplied on 22nd October 2013 – Lab Job No. J64551
Analysis requested by Steve Smith. Your reference Rose Hill 4/33

	SITE A1	SITE A1/2	SITE B1	SITE C1
Description	clay Loam	Clay Loam	Clay Loam	Clay Loam
Lab. Bulk Density(tonne/m^3)	1.37	1.38	1.38	1.39
Soil pH (1:5 $CaCl_2$)	5.10	5.14	5.10	5.09
Soil Conductivity (1:5 water dS/m)	0.123	0.085	0.102	0.102
Soil Conductivity (as Ec_e dS/m)[note 10]	1.180	1.119	1.179	0.995
Native NaOH Phosphorus (mg/Kg P)	7.58	8.0	7.60	7.90

Residual Phosphorus remaining in solution from initial phosphate phosphorus

Initial Phosphorus concentration (ppm P)	10	10	10	10
72 hour – 3 Day (ppm P)	9.23	9.31	9.25	9.30
96 hour – 4 Day(ppm P)	9.84	9.34	9.81	9.75
120 hour – 5 Day (ppm p)	9.42	9.59	8.45	8.55
144 hour – 6 Day (ppm P)	9.83	9.44	9.44	9.43
168 hour – 7 Day (ppm P)	9.32	9.33	9.33	9.33
Equilibrium Phosphorus (ppm P)	9.60	9.57	9.62	9.63

EXCANGEABLE CATIONS

Sodium ($cmol^+$/Kg)	0.47	0.68	0.40	0.31
Potassium ($cmol^+$/Kg)	0.25	0.41	0.24	0.31
Calcium ($cmol^+$/Kg)	3.16	3.45	3.00	2.86
Magnesium ($cmol^+$/Kg)	2.06	2.41	2.01	1.55
Hydrogen ($cmol^+$/Kg)	2.08	2.49	2.11	2.20
Aluminum ($cmol^+$/Kg)	0.56	0.83	0.50	0.27
ECEC (effective cation exchange capacity) ($cmol^+$/Kg)	8.57	10.27	8.45	7.50
Exchangeable Sodium Percentage (ESP)	5.4	3.6	5.3	4.5
Calcium Magnesium Ratio	1.55	1.24	1.50	1.74
Emersion Dispersion Index	Class 2	Class 2	Class 2	Class 2

Notes

1. ECEC = Effective Cation Exchange Capacity = sum of the exchangeable Mg, Ca, Na, k, h and Al
2. Exchangeable bases determined using the standard Gilman and Sumpter (1989) digest (Method 15E1) with no pretreatment for soluble salts. When Conductivity ≥0.25 dS/m soluble salts are removed (Method 15E2)
3. ppm = mg/Kg dried soil
4. Insitu P determined using 0.1M NaOH and shaking for 24 hours before determining phosphate
5. Soils were crushed using a ceramic grinding head and mill; five 1g subsamples of each soil were used to which 40ml of 0.1M NaCl with Xppm phosphate was added to each. The samples were shaken on an orbital shaker.
6. Exchangeable sodium percentage (ESP) is calculated as sodium ($cmol^+$/Kg) divided by ECEC.
7. All results as dry weight DW – soils were dried at 60C FOR 48hrs prior to crushing and analysis.
8. Phosphorus Capacity method Ryden and Pratt, 1980.
9. Aluminium detection limit is 0.05 $cmol^+$/Kg; hydrogen detection limit is 0.1 $cmol^+$/Kg. However for calculation purposes a value of 0 is used.
10. For conductivity 1 dS/cm = 1000 uS/cm; EC_e conversions: sand loam 14, loam 9.5; clay loam 8.6; heavy clay 5.8
11. 1 $cmol^+$/Kg c= 1 meq/100g

checked.....

APPENDIX D -WATER BALANCE CALCULATIONS.

MONTH	1. PREC MM	2 APP'D EFFL MM	3. TOTAL APP'D	4. EVAP0 TRANS MM	5.	6.	7. PERCOLATION MM	8. EVAP spay loss + leaf MM	3-(4+7 +8)=9. STORAGE MM	10. CUMULATIVE STORAGE MM
JAN	107.2	31	***138.2***	80			*124*	13.95	0	0
FEB	119.2	28	***147.2***	80			*112*	12.6	0	0
MAR	142.5	31	***171.5***	65			*124*	13.95	0	0
APRIL	130.7	30	***160.7***	55			*120*	13.5	0	0
MAY	119.4	31	***150.4***	35			*124*	13.95	0	0
JUN	123.6	30	***154.6***	35			*120*	13.5	0	0
JUL	88.3	31	***119.3***	30			*124*	13.95	0	0
AUG	80.7	31	***111.7***	35			*124*	13.95	0	0
SEP	73.4	30	***100.4***	45			*120*	13.5	0	0
OCT	86.8	31	***117.8***	65			*124*	13.95	0	0
NOV	89.5	30	***119.5***	85			*120*	13.5	0	0
DEC	92.7	31	***121.7***	85			*124*	13.95	0	0

TABLE: WATER BALANCE – Rose Valley Road Rose Valley NSW.
Note : Precipitation and evaporation interpolated from Bureau of Metrology maps for Kiama Bowling Club ; allowance for 1.0mm of applied effluent per day over 2,200 m^2.