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Wastewater Management Plan for Proposed Burmese Temple at 53 Dwyer Road, Bringelly NSW

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Disclaimer

The information contained in this report is based on independent research undertaken by Mark Saunders and Nicholas Banbrook of Whitehead & Associates Environmental Consultants Pty Ltd (W&A). To our knowledge, it does not contain any false, misleading or incomplete information. Recommendations are based on an appraisal of the site conditions subject to the limited scope and resources available for this project, and follow relevant industry standards. The work performed by W&A included a desktop review and limited soil sampling only, and the conclusions made in this report are based on the information gained and the assumptions as outlined. Under no circumstances, can it be considered that these results represent the actual state of the site at all points, as subsurface conditions are inherently variable. Concentrations of contaminants may also change with time, and the conclusions in this report have a limited lifespan.

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1 Introduction

Whitehead & Associates Environmental Consultants Pty Ltd (“W&A”) were engaged by Edmund Lui from VT Architects on behalf of Sasanadhaja Buddhist Association Inc. (“the Client”) to prepare an onsite Wastewater Management Plan (WWMP) for the proposed construction of a Burmese temple and associated infrastructure at 53 Dwyer Road, Bringelly (“the Site”).

This WWMP provides a detailed assessment of the conditions and constraints of the Site with regard to suitability for Onsite Sewage Management (OSSM). A conceptual design is provided, based on these constraints, for a sustainable onsite sewage treatment and effluent management system to enable development approval in accordance with the investigation and reporting requirements of Liverpool City Council (“Council”) Development Control Plan No. 47; Domestic On-site Sewage Management (DCP, 2002).

Other relevant standards and guidelines considered in our assessment and design process include AS/NZS 1547:2012 *On-Site Domestic Wastewater Management, Environment, Health Protection Guidelines: On-Site Sewage Management for Single Households* (NSW DLG, 1998), NSW Department of Water and Energy – Management of Private Recycled Water Schemes (DWE, 2008) and NSW Environmental Guidelines - *Use of Effluent by Irrigation* (DEC, 2004).

2 Scope of Works

The study methodology included, but was not limited to:

- reviewing a range of background information relevant to the project, including the development/design plans and any other relevant information from previous studies in the area;
- visiting the site (once) and undertaking detailed site investigations, assessing a range of site constraints including landform, slope, aspect, drainage, flooding and proximity to sensitive environments;
- undertaking a soil survey including the excavation of four boreholes to assess soil physical characteristics such as texture, structure, depth, colour, drainage and presence of water tables;
- undertaking in-house laboratory analysis of pH, electrical conductivity and Emerson Aggregate Class of the soil samples;
- providing a soil sample for independent lab analysis of phosphorus sorption and cation exchange capacity (nutrient modelling) and exchangeable sodium percentage (soil dispersion potential);
- estimating likely wastewater loads (quantity and quality) from the proposed development;
- assessing the overall site capability for onsite wastewater management and determine an appropriate level of wastewater treatment and the preferred method of land application of effluent to overcome the site constraints. These decisions will be made having regard to relevant standards and guidelines including AS/NZS 1547:2012 *On-Site Domestic Wastewater Management and Environment, Health Protection Guidelines: On-Site Sewage Management for Single Households* (NSW DLG, 1998), NRMCC, EPHC, AHMC (2006) *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks* (Phase 1), NSW DEC (2004) *Environmental Guidelines – Use of*

Effluent by Irrigation and relevant planning and environmental health protocols and guidelines currently in force by Council;

- undertaking water and nutrient balance calculations to determine the required land application area sizing for the proposed development and identify the suitable wastewater treatment options;
- identifying a short list of the most appropriate wastewater treatment and effluent reuse and/or disposal options to overcome the identified site constraints;
- identifying an appropriate location and configuration for the land application area for the proposed dwelling and providing a concept design of this;
- outlining any land improvement works or mitigation measures required to address particular constraints in the land application area (e.g. terracing, soil importation, vegetation improvement, landscaping, stormwater diversion);
- liaising with Council to discuss the proposal and confirm that it addresses the particular issues affecting the Site or development; and
- preparation of this written Onsite Wastewater Management Report, describing the results and recommendations from our investigations.

3 Site Description

The Site is presently un-sewered and potable water is serviced by tank (rain) water supply. There are no plans to connect to Sydney Water's reticulated mains water supply in the near future. The total area of the Site is approximately 3.2ha, with driveway access via Dwyer Road. The Site currently contains a residential dwelling in the eastern portion along with a separate garage, shed and smaller relocatable structures. Three large dam features are located on the property, with a fourth dam located immediately down slope of the southern property boundary.

The proposed multi-purpose development will comprise a temple / main shrine, a kitchen (for limited food preparation), amenities building and 28 space car park. A detailed Site Plan showing the proposed development extents and the available Effluent Management Area (EMA) is presented as Figure 1 in Appendix A.

4 Site & Soil Assessment

4.1 Site Physical Characteristics

A Site and Soil Assessment was undertaken on the 6th of June 2017 by Mark Saunders of Whitehead & Associates. A description of the Site physical conditions and the degree of limitation they pose to onsite effluent management is provided in Table 1 below. Reference is made to the rating scale in NSW DLG (1998).

Table 1: Site Physical Conditions & Constraints

Parameter	Constraint
Climate: Climatic data used in water balance calculations were obtained from Bureau of Meteorology (BoM) weather stations, namely; Bringelly (67015) and Prospect Reservoir (67019). The Site experiences a temperate climate, typical of south-eastern Australia. Potential evapotranspiration exceeds rainfall for 8 months of the year at the Site. The soil moisture deficit is expected to be most limiting during the autumn/winter period. This presents a moderate limitation to OSSM.	Moderate
Aspect and Exposure: Site aspect within the available EMA is predominantly south-west facing, with good solar and wind exposure.	Minor
Vegetation: The Site is primarily vegetated by lawn grasses and scattered mature trees of various species within proximity of the existing dwelling and property boundaries. There is good vegetation (grass) cover within the proposed EMA.	Minor
Landform and Slope: The Site is located on waxing divergent low-rises with slopes ranging between 2% and 10% within the available EMA. This presents a minor limitation to OSSM.	Minor
Rocks and Rock Outcrops: No bedrock or rock outcrops were observed on the ground surface or encountered during test pit excavations at the Site. This presents a minor limitation to OSSM.	Minor
Fill: Imported fill was not observed within proximity of the proposed EMA, or during test pit excavations. Fill is not expected to present a significant limitation to OSSM.	Minor
Erosion Potential: The proposed EMA appears generally stable with good ground cover and no erosion observed at the time of inspection.	Minor
Groundwater and Site Drainage: A search of the NSW Office of Water's groundwater bores, maps and records indicated that there are no registered groundwater bores within 250m of the Site. Surface drainage is considered to be generally good throughout the Site. Though, some mottling was observed in subsoils indicating periods of inhibited vertical drainage. This will be addressed through assignment of appropriate soil loading rates for effluent application.	Moderate

Parameter	Constraint
Flood Potential and Proximity to Surface Waters:	
Review of Council's 'Online Flood Risk Map' (ePortal) indicates that the Site is located well above both the 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) levels. Therefore, flooding is not expected to be a limitation for OSSM.	
There are three (3) dams located on the property. Two large dams are located to the centre/west of the Site and form part of a larger local drainage network. A smaller dam is isolated to the front (east) of the Site and receives only runoff from local road drainage.	Moderate to Major
Given the spatial constraints imposed by the proposed development, it is proposed to decommission and backfill the small dam located in the south eastern corner of the Site and utilise part of this area for effluent management.	
Based on this, proximity to surface waters is considered a moderate to major limitation for OSSM.	

4.2 Soil Landscape

A review the Soil Landscapes of the Penrith 1:100,000 Sheet (Bannerman and Hazelton, 1990) indicates that Site soils belong to the Blacktown (bt) soil landscape. The 'bt' soil landscape is located on gently undulating rises on the Wianamatta Group Shales in the Cumberland Lowlands. The topography consists of rounded crests and ridges with gently inclined slopes (convex upper slopes grading onto concave lower slopes), with a local relief of 10-30m and slopes <5%.

Soils are comprised of shallow to moderately deep (<100cm) of hardsetting mottled texture contrast soils, red and brown Podzolic soils on crests grading to yellow Podzolic soils on lower slopes and within drainage lines. A typical soil profile of the 'bt' soil landscape on the upper slopes/midslope position (<200cm total soil depth) is characterised as follows:

- (A1) 30cm moderately-structured, friable, brownish black loam to clay loam (sometimes absent), overlying;
- (A2) 2-50cm massive to weakly-structured, hardsetting, brown clay loam to silty clay loam with platy iron indurated shale fragments, overlying;
- (B) <100cm moderately-structured light grey plastic silty clay to heavy clay, mottling, strongly weathered ironstone concretions, overlying;
- shale bedrock.

Reported landscape limitations include moderately reactive highly plastic subsoil, low soil fertility, and (localised) poor soil drainage.

4.3 Soil Survey & Physical Characteristics

Site soils were observed and examined by excavating four (4) test pits (TPs) using a hand auger. Soils were generally consistent across the Site with topsoils composed of moderately structured clay loam to light clay material to 200mm depth; overlying a light to medium clay horizon to beyond 900mm depth with varying amounts of coarse fragment. Horizon boundaries were generally well defined. The descriptions are generally congruent with the Blacktown regional soil landscape (A2 and B).

The soil survey had two principal aims – to verify regional soil landscape mapping information and to assess local soil conditions in areas considered suitable for land application of effluent.

Table 2 summarises the key soil physical and chemical constraints. Appendix B provides soil borelog summaries for each test pit.

4.4 Soil Chemical Characteristics

Samples of all discrete soil horizons were collected for subsequent laboratory analysis. Samples were taken from each horizon and were analysed in-house for pH, Electrical Conductivity (ECe) and Emerson Aggregate Class. One composite soil sample was taken for independent laboratory analysis for key soil parameters including exchangeable sodium (ESP), cation exchange (CEC) and phosphorus sorption (P-sorp).

Table 2 provides a summary of the results and discussion of the soil chemistry with respect to soil constraints for land application of effluent. Reference is made to the rating scale described in Table 6 of DLG (1998). Raw data and interpretation is presented in Appendix C.

Table 2: Soil Physical /Chemical Characteristics & Constraints

Parameter	Constraint
Soil Depth: Soil depth in the vicinity of the preferred EMA is >0.9m. Bedrock was not encountered in any of the TPs during excavation.	Minor
Depth to water table: The depth of the vadose zone (i.e. non-saturated soil material above water table) is >0.9m. Minor-moderate mottling was observed towards the base (>0.4m) of the examined TPs, indicating some (seasonal) restrictions to drainage; however, based on topography and soil moisture characteristics, the depth to seasonal/permanent groundwater is not expected to be a limitation to OSSM.	Minor
Coarse Fragments (%): Coarse fragments may impede plant growth by reducing soil water holding capacity, nutrient retention capacity and overall fertility because of the reduced fine earth fraction and increased permeability. Approximately 30-40% gravel fragments were observed beyond 400mm depth within Test Pit three (TP3). All remaining TP horizons exhibited <10% coarse fragments. Based on this and the preferred land application method, coarse fragments are not expected to be a limitation to OSSM.	Minor
Soil Permeability and Design Loading Rates: Soil permeability was not directly measured but can be inferred from observed soil properties. AS/NZS 1547:2012 describes conservative Design Irrigation Rates (DIRs) for irrigation systems (Table M1), depending on two important soil properties – texture and structure. Soil depth, colour, mottling and drainage characteristics are also important to consider and guide selection of appropriate loading rates. Indicative permeability of the most limiting soil horizon within 600mm depth below the point of application for the preferred land application system (irrigation) is generally used to select an appropriate soil loading rate. This soil type is classified as a moderately structured Category 6 soil (medium clay) and can be described as poorly drained, with an indicative permeability (K_{sat}) of <0.06m/day. Soil permeability presents a major limitation to OSSM in the available EMA. Based on the low subsoil permeability and the preferred land application method, it is recommended that a minimum 250mm of good quality (sandy loam) topsoil be	Major

Parameter	Constraint
<p>imported to the EMAs prior to system installation.</p> <p>To utilise the preferred EMA in the front (eastern) lawn area, the small dam in the south eastern corner must be decommissioned and backfilled. The backfilled ground surface should be landscaped and overlain with a minimum 250mm depth of good quality (sandy loam) topsoil.</p> <p>Based upon slope, soil amelioration (see Section 8.1) and secondary effluent quality, the following conservative DIR is recommended for sizing the required Land Application Area (LAA):</p> <ul style="list-style-type: none"> 2.0mm/day (subsurface irrigation) 	
<p>pH:</p> <p>The pH of 1:5 soil/water suspensions were measured in-house using a <i>Hanna</i>™ hand held pH / EC meter. The measured pH of the soil samples ranged from 6.2 - 7.1 (topsoils) to 4.9 – 7.8 (subsoils), which are considered very strongly acidic to mildly alkaline respectively.</p> <p>Plant growth did not appear to be significantly impacted by soil pH at the time of inspection. Soil pH can be managed by amelioration and soil improvement practices if necessary to maintain vegetation health in the proposed LAAs.</p>	Moderate
<p>Electrical Conductivity (EC_e):</p> <p>Electrical conductivity of the saturated extract (EC_e) was calculated by first measuring the electrical conductivity of 1:5 soil in water suspensions and using appropriate multiplier factors (based on soil texture) to convert the 1:5 suspension EC to EC_e.</p> <p>All soil samples were found to be non-saline, having EC_e values of 0.03 – 1.37 dS/m. Soil salinity is not considered to pose a significant limitation for OSSM.</p>	Minor
<p>Modified Emerson Aggregate Class:</p> <p>The Modified Emerson Aggregate Test (EAT) is a measure of soil dispersibility and susceptibility to erosion and structural degradation. It assesses the physical changes that occur in a single air-dried ped (naturally forming aggregate) of soil when immersed in water; specifically whether the soil slakes and falls apart or disperses and clouds the water.</p> <p>The test was performed on all samples collected, which yielded Emerson Aggregate Classes ranging from 5 to 6. The EAT classifications indicate moderate levels of slaking and low to moderate levels of dispersion within subsoil horizons.</p> <p>Subsoil stability presents a moderate limitation to OSSM and will be managed through soil amelioration as described in Section 8.1.</p>	Moderate
<p>Sodicity (Exchangeable Sodium Percentage- ESP) (%):</p> <p>The Exchangeable Sodium Percentage (ESP) is the proportion of sodium on the cation exchange sites reported as percentage of exchangeable cations and is an important indicator of sodicity, which affects soil structural stability and susceptibility to dispersion. The ESP is a measure of how readily the soils allow sodium from recycled water to be substituted in the soil lattice for other cations. Once accepted, the weak sodium bonds allow increased structural degradation of the soil, increasing erosion risk. It is calculated as $[\% \text{ Na} / \text{CEC}] \times 100$.</p> <p>Hazleton & Murphy (2007) suggest:</p> <ul style="list-style-type: none"> ESP values less than 6 are rated as non-sodic; ESP values between 6 and 15 are rated as sodic; 	Minor

Parameter	Constraint
<ul style="list-style-type: none"> • ESP values between 15 and 25 are rated as strongly sodic; and • ESP values greater than 25 are rated as very strongly sodic. <p>The ESP measured for the composite sample was 0.9, indicating that Site soils are non-sodic. This presents a minor limitation for OSSM.</p>	
<p>Cation Exchange Capacity (cmol+/kg):</p> <p>The Cation Exchange Capacity (CEC) is the capacity of the soil to hold and exchange cations [aluminium, calcium, magnesium, potassium and sodium]. It is a major controlling agent for soil structural stability, nutrient availability for plants and the soils' reaction to fertilisers and other ameliorants (Hazelton & Murphy, 2007). Like ESP, the CEC is a measure of how easily the soils accept excess cations from the effluent. These cations are used by plants as a nutrient source; so the higher the CEC the more likely plant growth will be aided by the application of treated wastewater.</p> <p>The CEC of the composite soil sample analysed was measured at 25.6cmol+/kg (TP4). The CEC rating for the sample is considered high, indicating that plant growth is not likely to be inhibited by a lack of key soil nutrients such as calcium, magnesium and potassium.</p> <p>The calcium/magnesium ratio (4.0) was found to be high. It is generally accepted that the Ca/Mg ratio should be >2.0 to improve fertility and lower the risk of dispersion. This presents a minor constraint to OSSM.</p>	Minor
<p>Phosphorus Sorption Capacity (kg/ha):</p> <p>The Phosphorous Sorption Capacity (P-sorption) is used to calculate the potential immobilisation rate of phosphorous by the soil. The P-sorption capacity of a soil is an important feature that relates to the potential for a soil to bind any phosphorus that may not be utilised by the plants within an available EMA. Phosphorous is required only to a limited extent by plants as a trace nutrient, but if there is an excess of phosphorous in environments where other limiting factors are not present (such as waterways), excess phosphorous can result in very high plant growth. Typically, on land, excess phosphorous is taken up by soil adsorption, or is flushed out of the soil into groundwater or surface water bodies. In many instances, P-sorption will be the dominant phosphorus removal mechanism when applying recycled water to the land.</p> <p>The recorded P-sorption for the composite soil sample is 493mg/kg. This presents a minor limitation for OSSM.</p>	Minor

5 Buffers

Buffer distances from LAAs are recommended to minimise risk to public health, maintain public amenity and protect sensitive environments. Buffer or setback distances provide a form of mitigation against unidentified hazards and reduce potential pathways of human and environmental exposure. Council's DCP No. 47 (2002) requires the following environmental buffers for LAAs:

- 250m from domestic groundwater bores;
- 100m from permanent watercourses;
- 40m from intermittent watercourses and dams;
- 6m if area up-gradient and 3m if area down-gradient of driveways, swimming pools and buildings; and

- 6m if area up-gradient and 3m if area down-gradient of property boundaries.

The Site constraints analysis has identified approximately 3,760m² of suitable EMA that meets all of the aforementioned buffer distance requirements.

6 Wastewater Generation

6.1 Wastewater Quality

Wastewater generated by the development is expected to be of a typical domestic household nature. Kitchen facilities are to be provided; however, it is understood that these will only be used for 'simple' food preparation. As such, untreated wastewater is expected to have characteristics similar to that described in Table 3; which incorporates information taken from DLG (1998).

Table 3: Characteristics of Typical Untreated Domestic Wastewater

Parameter	Loading	Greywater %	Blackwater %
Daily Flow	--	65	35
Biochemical Oxygen Demand	200-300mg/L	35	65
Suspended Solids	200-300mg/L	40	60
Total Nitrogen	20-100mg/L	20-40	60-80
Total Phosphorus	10-25mg/L	50-70	30-50
Faecal Coliforms	10 ³ - 10 ¹⁰ cfu/100 mL	medium-high	high

The contaminants in domestic wastewater have the potential to create undesirable public health concerns and pollute waterways unless managed appropriately. As a result, domestic wastewater must be treated appropriately to remove the majority of pollutants to enable attenuation of the remaining pollutants through soil processes and plant uptake.

6.2 Wastewater Quantity

Existing

The proposal includes retention of an existing five (5) bedroom dwelling. For design purposes, the maximum occupancy of 7.5 residents (5 bedrooms) has been assumed. However, based on Client advice provided in the 'Plan of Management' (dated 7 June 2017); the expected occupancy throughout the majority of the year will only include two monks residing within the existing dwelling.

Proposed Facilities

The proposed development includes the following wastewater generation sources:

- Amenities Building (male/female toilets and wash facilities);
- Kitchen Facility; and the
- Temple / Shrine.

Additionally, several large events (including day time ceremonies) are proposed throughout the year with up to 105 persons expected to visit the Site. This 'peak' occupancy is only expected to occur on several occasions per year in response to specific events on the religious calendar. Based on these assumptions, maximum wastewater generation estimates have been calculated for the proposed development at the Site.

Generation estimates for Site facilities are based on flow allowances from Council's DCP No. 47 and Table H4 in AS/NZS1547:2012 for tank (rain) water supply. To minimise wastewater generation, the proposed development should be constructed in accordance with BASIX requirements, including a 40% reduction in the design flow allowance, based on installation of 'full- water reduction fittings':

- Taps – AAA rated;
- Toilets – 6/3 litre dual flush pan and cistern;
- Showers – 9L/minute; and
- Dishwashers (if used) – AAA rated using as little as 18 litres per wash.

Table 4 presents a summary of the maximum projected wastewater generation for the proposed facilities under both 'normal' and 'special' operating conditions.

Table 4: Wastewater Generation Summary

Source / Facility Usage	Design Flow Allowance (L/p/day) ¹	Unit	Number	Expected Wastewater Flow (L/day)	Peak Wastewater Flow (L/hr) ³
Normal Site Operations					
Existing Dwelling (Monk Accommodation) ²	140	Bedroom	5	1,050	131
Temple Day Visitors (weekday)	15	Person	10	150	19
Temple Day Visitors (weekend)	15	Person	25	375	47
Special Events					
Temple Day Visitors	15	Person	90	1,350	169
Special Events Day Staff	30	Person	10	300	38
Total hydraulic load during normal weekday operations				1,200	150
Total hydraulic load during normal weekend operations				1,425	178
Total (peak) hydraulic load during special events				2,700	338

Notes

1. Values based on AS/NZS 1547:2012 and Table 3 of Council's DCP No.47, where applicable.
2. Assumed bedroom occupancy is 1.5 persons.
3. Flow peaking factor - i.e. Daily Flow x 300%

6.2.1 Flow Equalisation

To accommodate the sporadic occurrence of the projected peak occupancy (special event) scenario, a flow balancing assessment has been undertaken to enable moderation of wastewater delivery to the treatment system. For modelling purposes, we have assumed that 'special events' will occur no more than two (2) times in any calendar month, with all other days generating 'normal' weekday or weekend loads as described. A copy of the flow balancing assessment is included in Appendix D.

Based on our calculations, a (design) hydraulic load of 1,600L/day can be achieved and is proposed as the minimum daily treatment volume required. To achieve this, our analysis recommends the installation of a (minimum) 3,500L balance tank.

The proposed balance tank should be fitted with a suitably sized macerating transfer pump with timed dosing cycles to allow regulated transfer of the design wastewater load (1,600L/day) throughout the course of the day. The flow balance tank should be installed below grade in an upslope position relative to the treatment system. A 100mm PVC discharge outlet (by-pass) should be installed to enable (gravity) overflow to the treatment system in the event of a higher than expected daily wastewater flow or power/pump failure.

7 Onsite Sewage Management Strategy

7.1 Existing OSSM System

The OSSM system currently servicing the existing five (5) bedroom dwelling comprises a domestic Aerated Wastewater Treatment System (AWTS - 'Bio-Septic') with surface irrigation of treated effluent in garden areas surrounding the rear of the dwelling (see Figure 1).

At the time of inspection, poor scum formation was observed within the treatment system. This is likely due to the VCP inlet and outlet T-pieces being absent, resulting in disturbance of the settling process and subsequent displacement of suspended solids from the system. Further, the existing LAA is not adequately sized to accommodate the wastewater load from the dwelling. The existing OSSM system is installed in the location proposed for the construction of a 28-space carpark. While it might be possible (with careful design and planning) to retain the existing system, W&A do not consider this to be an appropriate approach.

Therefore, W&A recommend the installation of a new OSSM treatment and land application system capable of managing the expected (balanced) wastewater load/s from the proposed development. It is further recommended to divert wastewater generated from the dwelling to a proposed 3.5kL flow balancing tank. This would require diversion of all gravity sewer pipe work to the flow balancing tank.

A (nominal) location for the new OSSM infrastructure (balance tank and treatment system) is presented in Figure 2 (Appendix A).

7.2 Treatment System Options

W&A have considered various treatment system options for the proposed development. Given the variable influent loading (particularly during special event periods) and the inherent Site and soil constraints identified, the number of treatment and land application system options considered suitable is limited.

Treatment within a NSW Ministry of Health accredited domestic secondary system capable of sustainably managing $\leq 2,000\text{L/day}$ is considered the most suitable option to service the proposed development.

NSW Ministry of Health provides accreditation for domestic secondary treatment systems in NSW. These systems are typically proprietary, stand-alone systems including (but not limited to):

- Aerated Wastewater Treatment Systems (AWTS);
- Aerobic Sand or Textile Filter Systems;
- Biological Filter Systems; and
- Membrane Filters.

Advice on suitable systems can be sought from W&A prior to system selection and submission of the Section 68 application required by Council. Final system selection will be the

responsibility of the owner; however, the Client has indicated preference for an AWTS. A detailed list of NSW Ministry of Health accredited systems can be found at:

<http://www.health.nsw.gov.au/environment/domesticwastewater/Pages/default.aspx>

Disinfection units are typically installed as a standard component of proprietary secondary treatment systems, or can be installed as an add-on by the system supplier. We recommend that a disinfection system is installed with the chosen system. Disinfection units typically use one or a combination of the following disinfection methods:

- Ultra Violet (UV) irradiation, or
- Chlorination

The selected treatment system must be able to treat the anticipated (balanced) hydraulic loads of 1,600L/day while consistently achieving the prescribed (minimum) secondary effluent quality standard.

A brief description of each of the aforementioned system types is provided in the following sections.

7.2.1 Aerated Wastewater Treatment Systems (AWTS)

AWTS are mechanically aerated tank-based systems, comprising either one or two separate tanks that typically employ the following processes:

- settling of solids and flotation of scum in an anaerobic primary chamber. This stage is omitted in some models and existing septic tanks could be used for this purpose as discussed previously;
- oxidation and consumption of organic matter through aerobic biological processes using mechanical aeration;
- clarification – secondary settling of solids;
- disinfection – usually by chlorination but occasionally using ultraviolet irradiation; and
- regular removal of accumulated sludge to maintain the process.

7.2.2 Media Filter Systems

Media filters provide secondary treatment for effluent that has already undergone primary treatment in a septic tank or similar device. They contain textile media configured to provide a very large surface area to volume ratio which hosts aerobic microorganisms that treat the effluent as it passes over the media, usually by gravity. Proprietary media filter systems typically incorporate the primary treatment tank into a stand-alone unit and recirculate a proportion of the treated effluent through the textile to improve effluent quality. The system is typically located below or at ground level.

Media filters are proven to be an effective and reliable secondary treatment device, consistently capable of achieving BOD <10mg/L and SS <10mg/L and often better.

The high density of the media filter material enables high loading rates and therefore a relatively small footprint. These systems are typically more capable of overcoming a lot of the constraints of AWTS listed above, while having significantly lower operating costs and better performance.

7.2.3 Membrane Filter Systems

Membrane technology is becoming well established in on-site and community wastewater management (as well as in the broader water industry). Membranes work by pushing or pulling

wastewater through a porous membrane, resulting in the removal of any particles that are larger than the design pore size. The level of filtration most commonly used in domestic wastewater treatment systems is microfiltration, with a pore diameter of 0.1 – 10 microns (μm) which generally meets tertiary treatment criteria.

Additional UV or chlorination is sometimes used, especially in areas with sensitive receiving environments. Membrane systems are significantly more expensive than other secondary treatment systems and have higher electricity use. From a financial point of view, adoption of these systems over other secondary systems is justifiable only if internal reuse of treated effluent is required (e.g. toilet flushing).

7.2.4 Recirculating Sand Filters

The recirculating sand filter system comprises a pre-treatment unit, a recirculation tank, and an open sand filter. Wastewater first flows into a septic tank for primary treatment. The partially clarified effluent from the primary treatment tank then flows into a recirculation tank. The volume of the recirculation tank should be at least equivalent to the design wastewater flow. Raw effluent from the septic tank and the sand filter filtrate are mixed in the recirculation tank and pumped back to the sand filter bed. The filtrate from the sand filter is collected by underdrains that are located at the bottom of the bed. After being collected in the underdrain, the treated effluent is transported to a discharge line for further treatment or disposal. Sand is a commonly used medium, but anthracite, mineral tailings, bottom ash, etc., have also been used.

7.3 Treated Effluent Quality

The selected wastewater treatment system is expected to achieve the following (minimum) secondary effluent quality standard based on the expected effluent quality for AWTs', as presented in Table 5 of Council's DCP No.47 (2002) and reproduced in Table 5 below.

The maximum nutrient concentration targets for the treated effluent have been adopted for nutrient balance modelling.

Table 5: Characteristics of Secondary Treated Domestic Effluent

Parameter	Loading
Biochemical Oxygen Demand	<20mg/L
Suspended Solids	<30mg/L
Total Nitrogen	<50mg/L
Total Phosphorus	<15mg/L
Total Faecal Coliforms (disinfected)	<30 cfu/100mL
Total Faecal Coliforms (non-disinfected)	up to 10^4 cfu/100mL
Dissolved Oxygen	<2mg/L

7.4 Recommended Treatment System

The recommended treatment system is a NSW ministry of Health accredited domestic AWTs designed to treat 'domestic' strength wastewater for up to a 10 person (10EP) or 2,000L/day equivalent. This treatment system design is robust, relatively low maintenance, can be installed as a single unit below grade (with a pressurised seal) or above ground and has a relatively moderate capital cost.

Ample area is available in the nominated location (see Figure 2) for installation of the recommended flow balancing tank and AWTs. The exact positioning of the selected treatment

system on-site will depend on local gradient and level controls to allow gravity feed to the treatment system from fixtures within the existing dwelling and proposed development and can be determined by the supplier/contractor prior to obtaining consent for installation of the system.

7.4.1 Operation, Monitoring and Maintenance

Successful performance of wastewater management systems relies on good operational practice as well as periodic monitoring and maintenance. Certain aspects of monitoring and maintenance will be the responsibility of the owner, while other matters will be addressed through routine servicing by a suitably qualified technician.

Domestic wastewater treatment systems are required to be serviced every three months (quarterly) by a suitably qualified technician in accordance with Council's DCP No.47 (2002). The subsurface irrigation system must also be maintained in accordance with the manufacturer's recommendations.

7.5 Land Application Options

Various land application options were considered including irrigation (surface and subsurface), effluent reuse mounds, evapotranspiration/absorption (ETA) beds and primary absorption trenches.

Conventional septic tanks with below-ground soil absorption trenches are considered undesirable given the presence of 'medium' clay subsoils with restricted vertical drainage occurring within the likely basal areas of the trenches and also very large trench lengths would be required using contemporary sizing methodologies which are impractical to service. ETA beds and effluent reuse mounds are considered unsuitable for similar reasons.

Effluent irrigation systems are by far the most popular management option for on-site systems installed in recent years. Properly designed irrigation systems apply effluent at much lower volumetric rates and over larger areas than absorption trenches and beds. Effluent is applied at a rate that more closely matches plant evapotranspiration requirements leading to more effective effluent reuse. The reliance on soil absorption is relatively low and hence the risk of contaminants accumulating in the soil or leaching to groundwater is also low.

Historically, surface spray irrigation has been the favoured method of managing secondary treated effluent; however, due to concerns over the potential for human contact with effluent and also the poor management practices that have been associated with "moveable" type spray lines, it is being used less commonly in new installations.

7.6 Recommended Land Application System

Pressurised distribution of secondary treated effluent through pressure-compensating subsurface drip irrigation (SSI) is considered most appropriate for the Site to assimilate the anticipated hydraulic load. The size and design of the LAA has been determined by water and nutrient balance modelling using relevant guidelines, as explained in the following sections.

7.6.1 Irrigation Area Description

The available EMA identified at the Site is within close proximity of the existing residence, as well as proposed open space / recreational area. The preferred type of irrigation for this public access area is pressure-compensating subsurface drip irrigation. The available EMA is approximately 3,760m²; with a preferred 1,350m² located toward the east of the property near the proposed development area (see Figure 2).

SSI is suitable within lawn and landscaped areas and applies effluent within the root-zone of plants for optimum irrigation efficiency. It is an ideal option for ensuring even, widespread coverage of the available irrigation area. Subsurface irrigation installation does not require any bulk materials or heavy machinery and irrigation lines can be simply installed with a small trench digger or “ditch-witch”.

Proprietary, pressure-compensating drip irrigation pipe designed for use with treated effluent should be used that will ensure distribution of effluent at uniform, controlled application rates. These products have been specifically designed for use with effluent and allow for the higher BOD₅, suspended solids, nutrient and biological loads usually present in effluent compared to potable water. They contain specially designed emitters that reduce the risk of blockage, typically incorporating chemicals that provide protection against root intrusion and biofilm development (e.g. Trifluralin). The dripper lines are coloured lilac to clearly identify that they are irrigating treated effluent.

Lateral pipes should be spaced to provide good and even coverage of the area they service. Generally they should be no more than 0.6m apart, and parallel to the contour.

An in-line 120µm disc filter may be installed to minimise the amount of solids entering the pipelines and emitters. This must be removed and cleaned regularly (at least at 3-monthly intervals). Alternately, a flush main may be installed to periodically clean-out the irrigation lines to provide effective long term performance. Either manual or automatic flush valves may be installed, with flush water directed back to the treatment system. Air release valves will be installed at the high points in individual irrigation areas to prevent soil particles being sucked into the lines at the end of pump cycles as pipelines depressurise.

7.6.2 Irrigation Area Sizing

Water and nutrient balance modelling was undertaken to determine sustainable application rates for the proposed development and to estimate the necessary size of the LAA required to manage the proposed hydraulic and nutrient load from the proposed development. The procedures for this generally follow the DLG (1998) guidelines. Appendix E contains the modelling outputs.

The water balance used is a monthly model adapted from the “Nominated Area Method” described in DLG (1998). These calculations determined minimum LAA size for the given effluent load for each month of the year. The water balance can be expressed by the following equation:

$\text{Precipitation} + \text{Effluent Applied} = \text{Evapotranspiration} + \text{Percolation} + \text{Storage}$
--

Irrigation areas are calculated to achieve no net excess (overflow) of water and hence zero storage for all months. The water balance conservatively assumes a retained rainfall coefficient of 0.8; that is, an estimated 80% of rainfall will percolate into the soil within the LAA and 20% will run off. Given the moderate slopes and good groundcover at the Site, this is considered a conservative value. The rainfall hydraulic load is incorporated into the water balance to ensure that runoff from the LAAs will not occur under typical (design) climate conditions.

A conservative nutrient balance was also undertaken, which calculates the minimum irrigation area requirements to enable nutrients to be assimilated by the soils and vegetation. The nutrient balance used here is based on the simplistic DLG (1998) methodology, but improves this by more accurately accounting for natural nutrient cycles and processes. It acknowledges that a proportion of nitrogen will be retained in the soil through processes such as ammonification (the conversion of organic nitrogen to ammonia) and a certain amount will be lost by denitrification,

microbial digestion and volatilisation (Patterson, 2003). Patterson (2002) estimates that these processes may account for up to 40% of total nitrogen lost from soil. In this case, a more conservative estimate of 20% is adopted for the nitrogen losses due to soil processes.

The water and nutrient balances were modelled using the design daily hydraulic load of 1,600L/day. Table 6 below contains the input data and results of the water and nutrient balance modelling.

Table 6: Inputs for and Results of Water and Nutrient Balance Modelling

Parameter	Units	Value	Comments
Effluent Load	L/day	1,600	Design Hydraulic Load
Precipitation	mm/month	Mean Monthly	BoM Station – Bringelly (67015)
Pan Evaporation	mm/month	Mean Monthly	BoM Station – Prospect Reservoir (67019)
Runoff Coefficient	unit less	0.8	Proportion of rainfall that remains onsite and infiltrates the soil, allowing for runoff
Crop Factor	unit less	0.4 – 0.7	Conservative annual value for turf grasses – adjusted for season
Design Irrigation Rate (DIR)	mm/day	2.0	Based on limiting soil texture (Cat 6)
Effluent total nitrogen concentration	mg/L	50	Expected (maximum) value based on domestic AWTS
Effluent total phosphorus concentration	mg/L	15	Expected (maximum) value based on domestic AWTS
Nitrogen conversion rate (soil processes)	annual percentage	20	Conservative estimate of in-soil conversion processes
Nitrogen plant uptake	kg/Ha/yr	260	Roughly half that expected of effluent irrigated pasture (NSW DEC, 2004)
Phosphorus plant uptake	kg/Ha/yr	30	Roughly half that expected of effluent irrigated pasture (NSW DEC, 2004)
Soil phosphorus sorption capacity	mg/kg	493	Based on laboratory analysis
Design system life	years	50	Reasonable service life for system
Minimum irrigation area for total nitrogen load, without off-site export	m ²	898	
Minimum irrigation area for total phosphorus load, without off-site export	m ²	1,119	
Minimum irrigation area for total hydraulic load, without storage	m ²	1,350	Limiting design criteria

Based on the modelling presented in Appendix E, the hydraulic load is the limiting factor for land application sizing. The monthly balance demonstrates that a minimum LAA of **1,350m²** would be required to assimilate the anticipated hydraulic and nutrient load from the proposed development without the need for wet weather storage.

7.6.3 Detailed Irrigation System Design and Management

A detailed land application system design is beyond the scope of this report; however, this should be prepared upon receipt of development approval and before installation of the system(s). The detailed design should be undertaken by an irrigation specialist experienced with wastewater applications. The design should include consideration of the following matters:

- the LAA should comprise time dosed irrigation zones, nominally ~450m² dosing zones, serviced by an automatic sequencing valve (or similar) to provide ample resting time between each zone;
- a complete plan and specification should be prepared for all new irrigation areas and equipment. This will include details on the type, capacity, operation and maintenance of all irrigation equipment, the irrigation pump(s), distribution pipework, cleaning/flushing valves, irrigation controller(s), filters and distribution valves;
- procedures for irrigation scheduling should be discussed, including information on timing and duration of irrigation, permissible daily application rates, monitoring of site and soil conditions to ensure that effluent is not irrigated when soils are saturated, recording of irrigation rates, maintaining water and nutrient budgets, vegetation pruning or harvesting regimes;
- any mitigation measures required to overcome specific site constraints such as localised stormwater run-on or runoff problems should be incorporated into the irrigation design;
- regular inspection of the irrigation area should be undertaken to ensure that the system is serviceable, is effectively distributing the effluent and is not resulting in overloading and soil saturation over all or part of the irrigation area;
- the irrigation lines should be flushed regularly following the installer's recommendations;
- all in-line filters (if fitted) must be removed and cleaned regularly following the installer's recommendations;
- vegetation within the irrigation area should be regularly cut or pruned and removed from the area to maintain nutrient budgets;
- the irrigation area should be fenced, or otherwise managed to ensure that vehicles do not enter the area as this poses a risk of damaging irrigation equipment and compacting soils, to the detriment of the system;
- effluent should not be irrigated when the soil is saturated, in order to prevent surface runoff of effluent as well as excessive deep drainage in saturated soils; and
- no structures should be built or placed within the identified irrigation area.

8 Mitigation Measures

8.1 Soil Improvement

Given some Site soils are identified as moderately dispersive, gypsum application is recommended. Unstable soils may be highly susceptible to erosion, structural decline; surface crusting and can have very low infiltration capacities and lower hydraulic conductivity. These properties can reduce the soils' capacity to sustainably manage wastewater over time.

Application of calcium mineral (gypsum) is a recognised way of reducing the effects of soil instability. It does this by supplying calcium to the affected soil and thereby elevating calcium concentrations with respect to sodium. Added calcium will improve the soil CEC and Ca/MG ratio, improving fertility, while reducing the potential for soil structural degradation. Gypsum is only slowly soluble in water, so simply broadcasting at the surface can be of limited benefit as it can take a long time for the calcium to penetrate and reach the deeper soil layers. Therefore, it is necessary to incorporate the amendment into the subsoil during construction of the subsurface irrigation system. A suitable gypsum application rate of approximately 1.0kg/m² should be used.

8.2 Vegetation Establishment and Management

Vegetation should be established within the proposed LAA. A complete vegetation cover is important to reduce the erosion hazard and optimise water and nutrient uptake. A good cover of turf (lawn grasses) will be suitable for the recommended land application method, as suggested in this report. Achieving a nutrient balance within a LAA relies on nutrients being taken up by vegetation and then exported with the cut vegetation (i.e. mown and clipping removed). This balance can only be maintained by removing the cut material from the area.

8.3 Stormwater Management

The performance of LAAs (and potentially treatment systems) can be adversely affected if stormwater is allowed to run onto these areas. This water should be directed away from the proposed LAA.

Any earth banks and drains should be stabilised as soon as possible to prevent erosion using vegetation or a suitable alternative. The outlet must be stabilised and must discharge water in a safe location where it will not create an erosion hazard or impact on structures. Any roof stormwater should be disposed outside effluent disposal/reuse areas.

9 Conclusions and Recommendations

Having undertaken detailed site and soil investigations, assessed the likely wastewater volumes and characteristics, and analysed the potential contamination risks, we conclude that onsite wastewater management would be sustainable for the proposed development at the Site. Specifically, we recommend the following:

- Installation of a NSW Ministry of Health accredited domestic AWTs (or similar) capable of treating a wastewater load of 1,600L/day to a secondary standard (with disinfection), in compliance with Table 5 of this report;
- Installation of a minimum 3,500L influent balancing tank to accommodate surge flows associated with the development;

The tank should be fitted with a suitably sized macerator pump, timer dosing mechanism and a 100mm PVC overflow (bypass). This tank should be positioned to accept gravity flow of raw wastewater from all wastewater generating facilities at the Site, as well as overflow to the selected treatment system;

- Installation of a minimum 1,350m² pressure-compensating subsurface irrigation (SSI) area (LAA), split evenly into time-dosed zones, with automatic sequencing between each;
- The small (isolated) dam in the southeast corner of the Site should be decommissioned and appropriately backfilled, as part of the OSSM system upgrade; and
- Vehicles and grazing animals must be prevented from entering the designated LAA. The area may need to be fenced or otherwise defined to ensure this is observed.

This completes our assessment of the capability of the proposed development at 53 Dwyer Road, Bringelly for on-site wastewater management.

Please do not hesitate to contact me on 02 4954 4996 if you have any questions.

10 References (Cited and Used)

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- NSW DEC (2004). *Environmental Guidelines – Use of Effluent by Irrigation*. NSW Department of Environment and Conservation, Sydney.
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- Patterson, R.A. (2006). *Consideration of soil salinity when assessing land application of effluent greywater*. Septic Safe Technical Note 01/6, NSW Department of Local Government, Sydney.
- Standards Australia / Standards New Zealand (2012). AS/NZS 1547:2012 *On-site Domestic-wastewater Management*.

Appendix A

Figures & Site Plans

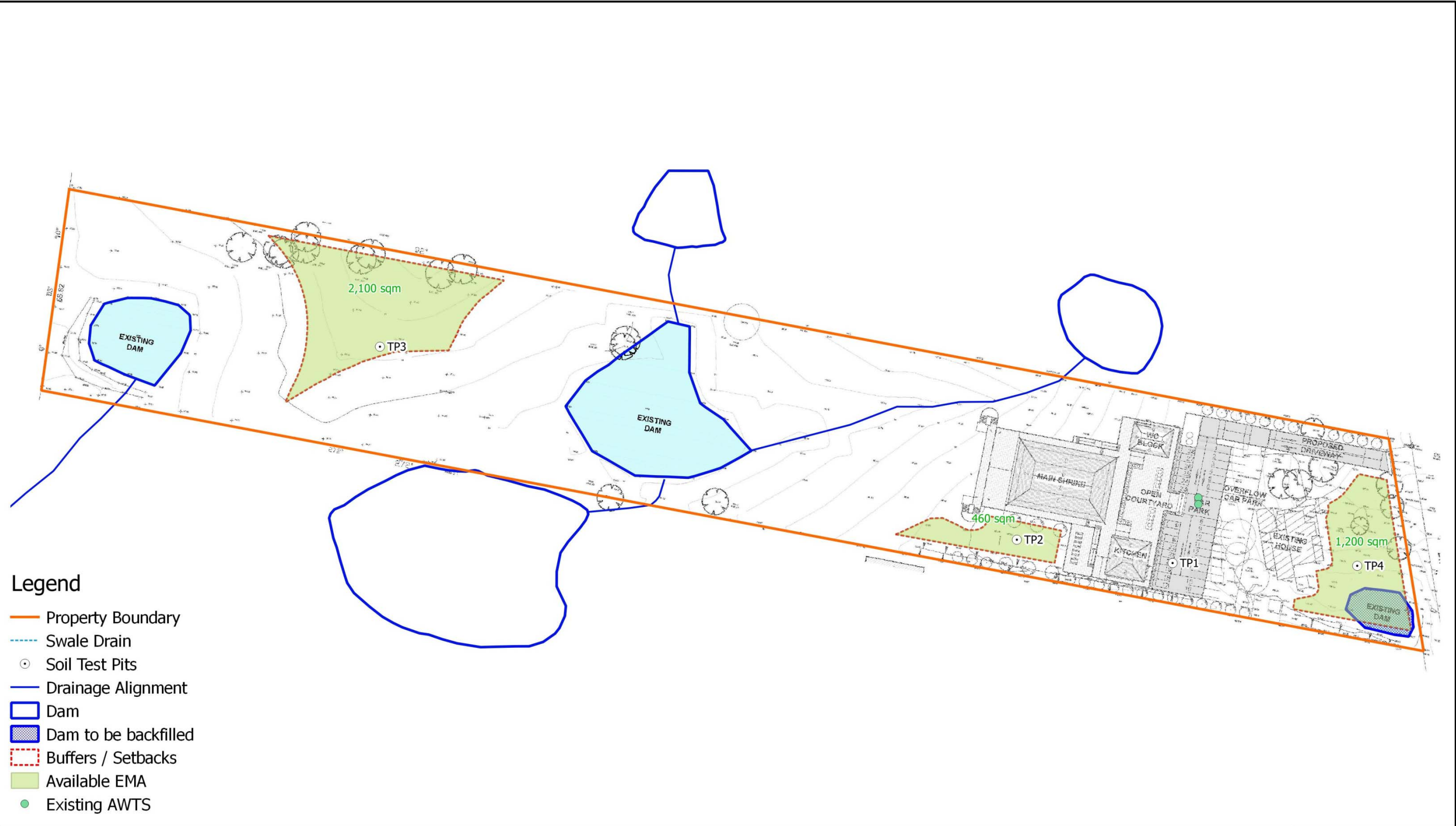



Figure 1: Site Plan Showing the Available Effluent Management Area

1816: Wastewater Management Plan for Proposed Burmese Temple at 53 Dwyer Rd, Bringelly

0 40 80 120 160 200 m
(Approx Scale)

 Whitehead & Associates Environmental Consultants	Revision	2
	Drawn	NB
	Approved	MS



1816: Wastewater Management Plan for Proposed Burmese Temple at 53 Dwyer Rd, Bringelly

<div><div>W</div><div>Whitehead & Associates</div><div>Environmental Consultants</div></div>	020406080 m		Revision2	
	(Approx Scale)		DrawnNB	
			ApprovedMS	

Appendix B

Soil Borelogs



Whitehead & Associates
Environmental Consultants Pty Ltd

Key to Soil Borelogs

Symbols






W Watertable depth ● Sample collected
X Depth of refusal





Moisture condition




D Dry
SM Slightly moist
M Moist
VM Very moist
W Wet / saturated


Graphic Log and Textures

	S - Sand LS - Loamy sand CS - Clayey sand		CL - Clay loam SCL - Sandy clay loam SiCL - Silty clay loam		Gravel (G)
	SL - Sandy loam		LC - Light clay SC - Sandy clay		Parent material (stiff)
	L - Loam LFS - Loam fine sandy SiL - Silty loam		MC - Medium clay HC - Heavy clay		Parent material (weathered)

SOIL BORE LOG						 Whitehead & Associates Environmental Consultants Pty Ltd				
Client:	VT Architects					Test Pit No:	TP1			
Site:	53 Dwyer Road, Bringelly					Excavated/logged by:	Mark Saunders			
Date:	6 June 2017					Excavation type:	Auger			
Notes:										
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture Condition	Comments
0.1			A1	LC	moderate	brown 7.5YR 4/2	nil	5-10% 5mm gravel	D	
0.2			A2	LC	moderate to well	brown 7.5YR 4/2	orange and grey	<10% 5mm gravel	SM	
0.3			B1	MC	weak to moderate	red 2.5YR 4/6	bright orange yellow and grey	<5%	M	
0.4										
0.5										
0.6										
0.7			B2	MC	moderate	red 2.5YR 4/6	bright orange yellow and grey	nil	SM	transitioning to yellow and grey beyond 0.9m
0.8										
0.9										
1.0		Test pit terminated at 0.9m depth								
1.1										
1.2										
1.3										
1.4										
1.5										

SOIL BORE LOG				 Whitehead & Associates Environmental Consultants Pty Ltd						
Client:	VT Architects			Test Pit No:	TP2					
Site:	53 Dwyer Road, Bringelly			Excavated/logged by:	Mark Saunders					
Date:	6 June 2017			Excavation type:	Auger					
Notes:										
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture Condition	Comments
0.1			A1	LC	moderate	brown 7.5YR 4/2	nil	5-10% 5mm gravel	D	
0.2			A2	LC	moderate to well	strong brown 7.5YR 5/6	orange	<5% fine gravel	SM	
0.3			B1	MC	weak to moderate	light yellowish brown 10YR 6/4	orange yellow and grey	nil	SM	
0.4										
0.5										
0.6										
0.7			B2	MC	moderate to well	red 2.5YR 4/6	orange (50%) pale grey	nil	SM	
0.8										
0.9										
1.0		Test pit terminated at 0.9m depth								
1.1										
1.2										
1.3										
1.4										
1.5										

SOIL BORE LOG				 Whitehead & Associates Environmental Consultants Pty Ltd						
Client:	VT Architects			Test Pit No:	TP3					
Site:	53 Dwyer Road, Bringelly			Excavated/logged by:	Mark Saunders					
Date:	6 June 2017			Excavation type:	Auger					
Notes:										
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture Condition	Comments
0.1			A1	SiCL	moderate to weak	dark brown 10YR 3/3	nil	<5% angular cobbles	D	
0.2			A2	SiCL	moderate	dark brown 10YR 3/3	red	<5% fine gravel	D	
0.3										
0.4			B1	LC	weak to moderate	yellowish red 5YR 4/6	red, orange and grey	<5% fine gravel	SM	
0.5			B2	LC	moderate to well	yellowish brown 10YR 5/6	minor yellow	30-40%	SM	
0.6										
0.7										
0.8		Test pit terminated at 0.7m depth								
0.9										
1.0										
1.1										
1.2										
1.3										
1.4										
1.5										

<h1>SOIL BORE LOG</h1>						 <div style="display: inline-block; vertical-align: middle;"> Whitehead & Associates Environmental Consultants Pty Ltd </div>				
Client:	VT Architects				Test Pit No:	TP4				
Site:	53 Dwyer Road, Bringelly				Excavated/logged by:	Mark Saunders				
Date:	6 June 2017				Excavation type:	Auger				
Notes:										
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture Condition	Comments
0.1	[Graphic Log Area]		A1	LC	moderate	dark reddish brown 5YR 3/2	nil	<2%	SM	
0.2			A2	MC	moderate	yellowish brown 10YR 5/6	nil	<2%	SM	
0.3										
0.4			B1	MC	moderate	yellowish brown 10YR 5/6	minor yellow and orange	<2%	SM	
0.5										
0.6										
0.7										
0.8		Test pit terminated at 0.7m depth								
0.9										
1.0										
1.1										
1.2										
1.3										
1.4										
1.5										

Appendix C

Raw Soil Data and Analytical Results

53 Dwyer Road, Bringelly - Soil Sampling Schedule and Results of pH, EC and Emerson Aggregate Test Analysis											
Site	Sample Name	Sample Depth (mm)	Texture Class	EAT [1]	Rating [2]	pH 1:5 [4]	Rating	EC 1:5 (µS/cm)	ECe (dS/m) [5]	Rating	Other analysis [6]
TP1	1/1	100	LC	6	Low	6.6	Neutral	33	0.26	Non-saline	
	1/2	250	LC	6	Low	7.1	Neutral	27	0.22	Non-saline	
	1/3	600	MC	5	Low	7.3	Neutral	14	0.10	Non-saline	
	1/4	900	MC	5	Low	6.1	Slightly acid	42	0.29	Non-saline	
TP2	2/1	100	LC	6	Low	6.2	Slightly acid	12	0.10	Non-saline	
	2/2	250	LC	5	Low	6.2	Slightly acid	5	0.04	Non-saline	
	2/3	600	MC	5	Low	4.9	Very strongly acid	100	0.70	Non-saline	
	2/4	900	LC	5	Low	6.0	Moderately acid	17	0.14	Non-saline	
TP3	3/1	150	CL	6	Low	6.1	Slightly acid	4	0.04	Non-saline	
	3/2	300	CL	6	Low	5.9	Moderately acid	3	0.03	Non-saline	
	3/3	400	LC	5	Low	6.3	Slightly acid	12	0.10	Non-saline	
	3/4	700	LC	5	Low	6.7	Neutral	16	0.13	Non-saline	
TP4	4/1	150	LC	6	Low	6.3	Slightly acid	142	1.14	Non-saline	
	4/2	300	MC	5	Low	6.9	Neutral	30	0.21	Non-saline	
	4/3	700	MC	6	Low	7.8	Mildly alkaline	196	1.37	Non-saline	
Notes:- (also refer Interpretation Sheet 1) [1] The modified Emerson Aggregate Test (EAT) provides an indication of soil susceptibility to dispersion. [2] Ratings describe the likely hazard associated with land application of treated wastewater. [3] pH measured in the field using Raupac Indicator. [4] pH measured on 1:5 soil:water suspensions using a <i>Hanna Combo</i> hand-held pH/EC/temp meter. [5] Electrical conductivity of the saturated extract (ECe) = $EC_{1:5}(\mu S/cm) \times MF / 1000$. Units are dS/m. MF is a soil texture multiplication factor. [6] External laboratories used for the following analyses, if indicated: <ul style="list-style-type: none"> • CEC (Cation exchange capacity) • Psorb (Phosphorus sorption capacity) • Bray Phosphorus • Organic carbon • Total nitrogen 											

Soil Laboratory Analysis Summary - 53 Dwyer Road, Bringelly

Site	Name	Depth (mm)	CEC (me/100g)		Ca (mg/kg)		Mg (mg/kg)		Na (mg/kg)		K (mg/kg)		ESP (%)		P-sorp. (mg/kg)	
1816	TP4 - Composite	700	25.6	H	4021	VH	606	H	53	L	112	L	0.9	NS	493	H

Phone Office/Lab (02) 6775 1157
 email: lanfaxlabs@bigpond.com.au
 Website: <http://www.lanfaxlabs.com.au>
 Lab address: 493 Old Inverell Road
 Postal address: PO Box 4690 Armidale NSW 2350
 Director: Dr Robert Patterson FIEAust, CPSS, CPAG
 Soil Scientists and Environmental Engineers



26th June 2017

Whitehead & Associates
 197 Main Road
 Cardiff NSW 2285

Soil Report: Job No. 1816 , one sample
 Sample date: Received 22nd June 2017
 Samples dried to 50°C, crushed and sieved to minus 2 mm prior to analysis

Whitehead & Associates-JUN17													
Site Location	Exc. Al+H	Ca		K		Mg		Na		Base Sat.	ESP	CEC	Ca/Mg
Sample ID	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	%	%	cmol+/kg	ratio
Whitehead & A, 1816, TP4 comp	0.0	4021	20.06	112	0.29	606	4.99	53	0.23	100.0	0.9	25.6	4.0

Methods: Rayment & Lyons 2011
 P sorption modified method 9J1 - elevated equilibrating solutions, ICP determination of P
 Cations: Method 15D3, no pretreatment
 Exchangeable Acidity: Method 15G1

Yours faithfully,

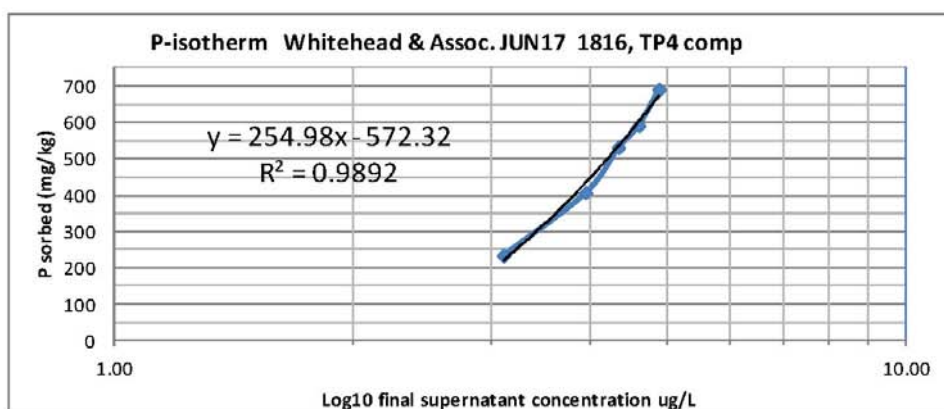
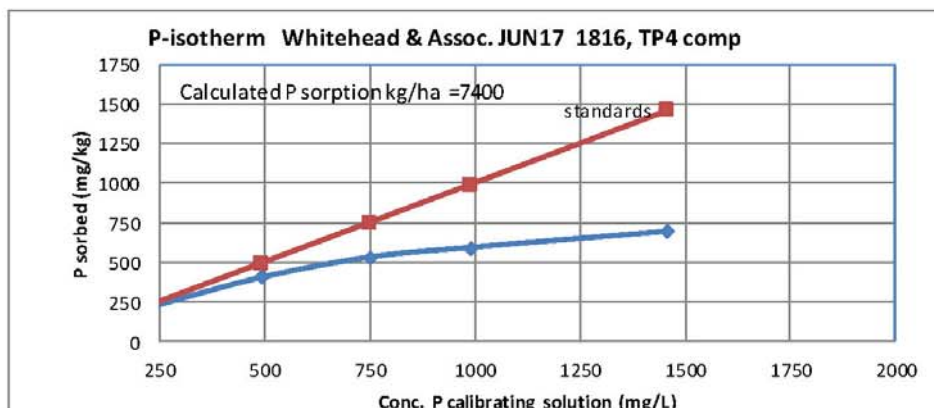
Dr Robert Patterson FIEAust, CPSS(3), CPAG
 Soil Scientist and Environmental Engineer



Commercial and research laboratory for soil, water and plant analysis.
 Soil survey and analytical assessments, landscape analysis and plant nutrient relationships,
 Wastewater and effluent reuse specialists - on-site and decentralised

Lanfax Labs. Armidale

Soil Results



Percent sorbed is the proportion of the initial P sorbed during equilibration					P-isotherm Whitehead & Assoc. JUN17 18			
Initial P	filtrate	sorbed P	Sample	Percent	Std line	filtrate	X-axis	Y-axis
mgP/L	P	mg/kg	I.D.	sorbed		C	Log C	
	mg/L			(%)		ugP/L		
24.7	1.27	234.6	Whitehead & Assoc. JUN17	94.9	247	1271	3.10	234.6
49.3	8.68	406.2	1816, TP4 comp	82.4	493	8675	3.94	406.2
74.9	21.73	531.7		71.0	749	21731	4.34	531.7
98.9	39.63	592.4		59.9	989	39630	4.60	592.4
145.6	76.39	692.5		47.6	1456	76387	4.88	692.5
Calculated P sorption kg/ha = 7400								

Appendix D

Flow Balancing Assessment

Influent Flow Balancing Assessment

Date	Facility Usage	Day	Daily Wastewater Input (L/day)	Design Treatment Volume (L/day)	Stored Water (L)	Stored Water from Previous Day (L)	Cumulative Wastewater Storage (L)	Cumulative Storage (L)	Balancing Storage Volume Required (L)
1/04/17	normal weekday	Monday	1,200	1,600	-400				3,300
2/04/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0	
3/04/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0	
4/04/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0	
5/04/17	normal weekday	Friday	1,200	1,600	-400	0	0	0	
6/04/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0	
7/04/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
8/04/17	special event	Monday	2,700	1,600	1,100		1,100	1,100	
9/04/17	special event	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200	
10/04/17	special event	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300	
11/04/17	normal weekday	Thursday	1,200	1,600	-400	2,900	2,900	2,900	
12/04/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500	
13/04/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325	
14/04/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150	
15/04/17	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750	
16/04/17	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350	
17/04/17	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950	
18/04/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550	
19/04/17	normal weekday	Friday	1,200	1,600	-400	550	150	150	
20/04/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0	
21/04/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
22/04/17	normal weekday	Monday	1,200	1,600	-400	0	0	0	
23/04/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0	
24/04/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0	
25/04/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0	
26/04/17	normal weekday	Friday	1,200	1,600	-400	0	0	0	
27/04/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0	
28/04/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
29/04/17	special event	Monday	2,700	1,600	1,100	0	1,100	1,100	
30/04/17	special event	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200	
1/05/17	special event	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300	
2/05/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900	
3/05/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500	
4/05/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325	
5/05/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150	
6/05/17	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750	
7/05/17	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350	
8/05/17	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950	
9/05/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550	
10/05/17	normal weekday	Friday	1,200	1,600	-400	550	150	150	
11/05/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0	
12/05/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
13/05/17	normal weekday	Monday	1,200	1,600	-400	0	0	0	
14/05/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0	
15/05/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0	
16/05/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0	
17/05/17	normal weekday	Friday	1,200	1,600	-400	0	0	0	
18/05/17	normal weekend	Saturday	1,425	1,600	-175	0	-175	0	
19/05/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
20/05/17	special event	Monday	2,700	1,600	1,100	0	1,100	1,100	
21/05/17	special event	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200	
22/05/17	special event	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300	
23/05/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900	
24/05/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500	
25/05/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325	
26/05/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150	
27/05/17	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750	
28/05/17	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350	
29/05/17	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950	
30/05/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550	
31/05/17	normal weekday	Friday	1,200	1,600	-400	550	150	150	
1/06/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0	
2/06/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
3/06/17	normal weekday	Monday	1,200	1,600	-400	0	0	0	
4/06/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0	
5/06/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0	
6/06/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0	
7/06/17	normal weekday	Friday	1,200	1,600	-400	0	0	0	
8/06/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0	
9/06/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
10/06/17	special event	Monday	2,700	1,600	1,100	0	1,100	1,100	
11/06/17	special event	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200	
12/06/17	special event	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300	
13/06/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900	
14/06/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500	
15/06/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325	
16/06/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150	
17/06/17	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750	
18/06/17	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350	
19/06/17	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950	
20/06/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550	
21/06/17	normal weekday	Friday	1,200	1,600	-400	550	150	150	
22/06/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0	
23/06/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
24/06/17	normal weekday	Monday	1,200	1,600	-400	0	0	0	
25/06/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0	
26/06/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0	
27/06/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0	
28/06/17	normal weekday	Friday	1,200	1,600	-400	0	0	0	
29/06/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0	
30/06/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
1/07/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100	
2/07/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200	
3/07/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300	
4/07/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900	
5/07/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500	
6/07/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325	
7/07/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150	
8/07/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750	
9/07/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350	
10/07/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950	
11/07/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550	
12/07/17	normal weekday	Friday	1,200	1,600	-400	550	150	150	
13/07/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0	
14/07/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
15/07/17	normal weekday	Monday	1,200	1,600	-400	0	0	0	
16/07/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0	
17/07/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0	
18/07/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0	
19/07/17	normal weekday	Friday	1,200	1,600	-400	0	0	0	
20/07/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0	
21/07/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0	
22/07/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100	
23/07/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200	
24/07/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300	
25/07/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900	
26/07/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500	
27/07/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325	
28/07/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150	
29/07/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750	
30/07/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350	
31/07/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950	

1816: Wastewater Management Plan for Proposed Burmese Temple at 53 Dwyer Road, Bringelly

Date	Facility Usage	Day	Daily Wastewater Input (L/day)	Design Treatment Volume (L/day)	Stored Water (L)	Stored Water from Previous Day (L)	Cumulative Wastewater Storage (L)	Cumulative Storage (L)
1/08/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
2/08/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
3/08/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
4/08/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
5/08/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
6/08/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
7/08/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
8/08/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
9/08/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
10/08/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
11/08/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
12/08/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
13/08/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
14/08/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
15/08/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
16/08/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
17/08/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325
18/08/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
19/08/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
20/08/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
21/08/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
22/08/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
23/08/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
24/08/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
25/08/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
26/08/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
27/08/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
28/08/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
29/08/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
30/08/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
31/08/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
1/09/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
2/09/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
3/09/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
4/09/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
5/09/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
6/09/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
7/09/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325
8/09/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
9/09/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
10/09/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
11/09/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
12/09/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
13/09/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
14/09/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
15/09/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
16/09/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
17/09/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
18/09/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
19/09/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
20/09/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
21/09/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
22/09/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
23/09/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
24/09/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
25/09/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
26/09/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
27/09/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
28/09/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325
29/09/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
30/09/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
1/10/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
2/10/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
3/10/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
4/10/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
5/10/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
6/10/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
7/10/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
8/10/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
9/10/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
10/10/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
11/10/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
12/10/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
13/10/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
14/10/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
15/10/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
16/10/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
17/10/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
18/10/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
19/10/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325
20/10/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
21/10/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
22/10/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
23/10/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
24/10/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
25/10/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
26/10/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
27/10/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
28/10/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
29/10/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
30/10/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
31/10/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
1/11/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
2/11/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
3/11/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
4/11/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
5/11/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
6/11/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
7/11/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
8/11/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
9/11/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325
10/11/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
11/11/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
12/11/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
13/11/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
14/11/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
15/11/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
16/11/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
17/11/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
18/11/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
19/11/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
20/11/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
21/11/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
22/11/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
23/11/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
24/11/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
25/11/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
26/11/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
27/11/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
28/11/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
29/11/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
30/11/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325

1816: Wastewater Management Plan for Proposed Burmese Temple at 53 Dwyer Road, Bringelly

Date	Facility Usage	Day	Daily Wastewater Input (L/day)	Design Treatment Volume (L/day)	Stored Water (L)	Stored Water from Previous Day (L)	Cumulative Wastewater Storage (L)	Cumulative Storage (L)
1/12/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
2/12/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
3/12/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
4/12/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
5/12/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
6/12/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
7/12/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
8/12/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
9/12/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
10/12/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
11/12/17	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
12/12/17	normal weekday	Thursday	1,200	1,600	-400	0	0	0
13/12/17	normal weekday	Friday	1,200	1,600	-400	0	0	0
14/12/17	normal weekend	Saturday	1,425	1,600	-175	0	0	0
15/12/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
16/12/17	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
17/12/17	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
18/12/17	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
19/12/17	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
20/12/17	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
21/12/17	normal weekend	Saturday	1,425	1,600	-175	2,500	2,325	2,325
22/12/17	normal weekend	Sunday	1,425	1,600	-175	2,325	2,150	2,150
23/12/17	special event	Monday	1,200	1,600	-400	2,150	1,750	1,750
24/12/17	special event	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
25/12/17	special event	Wednesday	1,200	1,600	-400	1,350	950	950
26/12/17	normal weekday	Thursday	1,200	1,600	-400	950	550	550
27/12/17	normal weekday	Friday	1,200	1,600	-400	550	150	150
28/12/17	normal weekend	Saturday	1,425	1,600	-175	150	0	0
29/12/17	normal weekend	Sunday	1,425	1,600	-175	0	0	0
30/12/17	normal weekday	Monday	1,200	1,600	-400	0	0	0
31/12/17	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
1/01/18	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
2/01/18	normal weekday	Thursday	1,200	1,600	-400	0	0	0
3/01/18	normal weekday	Friday	1,200	1,600	-400	0	0	0
4/01/18	normal weekday	Saturday	1,425	1,600	-175	0	0	0
5/01/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
6/01/18	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
7/01/18	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
8/01/18	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
9/01/18	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
10/01/18	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
11/01/18	normal weekday	Saturday	1,425	1,600	-175	2,500	2,325	2,325
12/01/18	normal weekday	Sunday	1,425	1,600	-175	2,325	2,150	2,150
13/01/18	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750
14/01/18	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
15/01/18	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950
16/01/18	normal weekday	Thursday	1,200	1,600	-400	950	550	550
17/01/18	normal weekday	Friday	1,200	1,600	-400	550	150	150
18/01/18	normal weekday	Saturday	1,425	1,600	-175	150	0	0
19/01/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
20/01/18	normal weekday	Monday	1,200	1,600	-400	0	0	0
21/01/18	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
22/01/18	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
23/01/18	normal weekday	Thursday	1,200	1,600	-400	0	0	0
24/01/18	normal weekday	Friday	1,200	1,600	-400	0	0	0
25/01/18	normal weekday	Saturday	1,425	1,600	-175	0	0	0
26/01/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
27/01/18	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
28/01/18	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
29/01/18	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
30/01/18	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
31/01/18	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
1/02/18	normal weekday	Saturday	1,425	1,600	-175	2,500	2,325	2,325
2/02/18	normal weekday	Sunday	1,425	1,600	-175	2,325	2,150	2,150
3/02/18	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750
4/02/18	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
5/02/18	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950
6/02/18	normal weekday	Thursday	1,200	1,600	-400	950	550	550
7/02/18	normal weekday	Friday	1,200	1,600	-400	550	150	150
8/02/18	normal weekday	Saturday	1,425	1,600	-175	150	0	0
9/02/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
10/02/18	normal weekday	Monday	1,200	1,600	-400	0	0	0
11/02/18	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
12/02/18	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
13/02/18	normal weekday	Thursday	1,200	1,600	-400	0	0	0
14/02/18	normal weekday	Friday	1,200	1,600	-400	0	0	0
15/02/18	normal weekday	Saturday	1,425	1,600	-175	0	0	0
16/02/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
17/02/18	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
18/02/18	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
19/02/18	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
20/02/18	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
21/02/18	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
22/02/18	normal weekday	Saturday	1,425	1,600	-175	2,500	2,325	2,325
23/02/18	normal weekday	Sunday	1,425	1,600	-175	2,325	2,150	2,150
24/02/18	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750
25/02/18	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
26/02/18	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950
27/02/18	normal weekday	Thursday	1,200	1,600	-400	950	550	550
28/02/18	normal weekday	Friday	1,200	1,600	-400	550	150	150
1/03/18	normal weekday	Saturday	1,425	1,600	-175	150	0	0
2/03/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
3/03/18	normal weekday	Monday	1,200	1,600	-400	0	0	0
4/03/18	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
5/03/18	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
6/03/18	normal weekday	Thursday	1,200	1,600	-400	0	0	0
7/03/18	normal weekday	Friday	1,200	1,600	-400	0	0	0
8/03/18	normal weekday	Saturday	1,425	1,600	-175	0	0	0
9/03/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
10/03/18	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100
11/03/18	normal weekday	Tuesday	2,700	1,600	1,100	1,100	2,200	2,200
12/03/18	normal weekday	Wednesday	2,700	1,600	1,100	2,200	3,300	3,300
13/03/18	normal weekday	Thursday	1,200	1,600	-400	3,300	2,900	2,900
14/03/18	normal weekday	Friday	1,200	1,600	-400	2,900	2,500	2,500
15/03/18	normal weekday	Saturday	1,425	1,600	-175	2,500	2,325	2,325
16/03/18	normal weekday	Sunday	1,425	1,600	-175	2,325	2,150	2,150
17/03/18	normal weekday	Monday	1,200	1,600	-400	2,150	1,750	1,750
18/03/18	normal weekday	Tuesday	1,200	1,600	-400	1,750	1,350	1,350
19/03/18	normal weekday	Wednesday	1,200	1,600	-400	1,350	950	950
20/03/18	normal weekday	Thursday	1,200	1,600	-400	950	550	550
21/03/18	normal weekday	Friday	1,200	1,600	-400	550	150	150
22/03/18	normal weekday	Saturday	1,425	1,600	-175	150	0	0
23/03/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
24/03/18	normal weekday	Monday	1,200	1,600	-400	0	0	0
25/03/18	normal weekday	Tuesday	1,200	1,600	-400	0	0	0
26/03/18	normal weekday	Wednesday	1,200	1,600	-400	0	0	0
27/03/18	normal weekday	Thursday	1,200	1,600	-400	0	0	0
28/03/18	normal weekday	Friday	1,200	1,600	-400	0	0	0
29/03/18	normal weekday	Saturday	1,425	1,600	-175	0	0	0
30/03/18	normal weekday	Sunday	1,425	1,600	-175	0	0	0
31/03/18	normal weekday	Monday	2,700	1,600	1,100	0	1,100	1,100

Appendix E

Water & Nutrient Balance Modelling

Nominated Area Water Balance & Storage Calculations

Site Address: 53 Dwyer Rd, Bringelly NSW

INPUT DATA

Design Wastewater Flow	Q	1,600	L/day
Design Irrigation Rate	DIPR	14	mm/week
Daily DJR		2	mm/day
Nominated Land Application Area	L	1,350	m ²
Crop Factor	C	0.4-0.7	unitless
Runoff Coefficient		0.8	unitless
Rainfall Data		Bringelly (67015)	
Evaporation Data		Prospect Reservoir (67019)	

Litres per sq.m. per day - based on Table M1 AS/NZS 1547:2012 for LC and secondary effluent

Available Effluent Management Area

Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type

Proportion of rainfall that remains onsite and infiltrates; function of slope/cover, allowing for any runoff

Mean Monthly Data (1867 - 2017)

Mean Monthly Data (1965 - 2015)

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365.0
Rainfall	R		mm/month	83.2	85.2	80.9	69.4	62.7	66	47	42	43.6	54.4	67.2	64.1	765.7
Evaporation	E		mm/month	192.2	145.6	130.2	96	74.4	63	74.4	102.3	132	161.2	174	204.6	1,549.9
Crop Factor	C		mm/month	0.7	0.7	0.7	0.6	0.5	0.45	0.4	0.45	0.55	0.65	0.7	0.7	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	135	102	91	58	37	28	30	46	73	105	122	143	968.9
Percolation	B	(DIPR/7)xD	mm/month	62.0	56	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.0
Outputs		ET+B	mm/month	196.5	157.92	153.1	117.6	99.2	88.4	91.8	108.0	132.6	166.8	181.8	205.2	1,698.9
INPUTS																
Retained Rainfall	RR	R*runoff coef	mm/month	66.56	68.16	64.72	55.52	50.16	52.8	37.6	33.6	34.88	43.52	53.76	51.28	612.6
Effluent Irrigation	W	(OxD)/L	mm/month	36.7	33.2	36.7	35.5	36.7	35.5	36.7	36.7	35.5	36.7	35.5	36.7	432.5
Inputs		RR+W	mm/month	103.3	101.3	101.5	91.1	86.9	88.3	74.3	70.3	70.4	80.3	89.3	88.0	1,045.1
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-93.2	-56.6	-51.7	-26.5	-12.3	0.0	-17.4	-37.7	-62.2	-86.5	-92.5	-117.2	-202.2
Cumulative Storage	M		mm													
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0.0												
LAND AREA REQUIRED FOR ZERO STORAGE				382	499	561	773	1011	1350	916	666	491	402	375	322	
MINIMUM AREA REQUIRED FOR ZERO STORAGE:				1,350 m²												

Nutrient Balance

Site Address: 53 Dwyer Rd, Bringelly NSW

Please read the attached notes before using this spreadsheet.

SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON THE MOST LIMITING BALANCE =

1,119 m²

INPUT DATA ^[1]					
Wastewater Loading			Nutrient Crop Uptake		
Hydraulic Load	1,600	L/Day	Crop N Uptake	260	kg/ha/yr which equals 71 mg/m ² /day
Effluent N Concentration	50	mg/L	Crop P Uptake	30	kg/ha/yr which equals 8 mg/m ² /day
% Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal	Phosphorus Sorption		
Total N Loss to Soil	16,000	mg/day	P-sorption result	493	mg/kg which equals 4,831 kg/ha
Remaining N Load after soil loss	64,000	mg/day	Bulk Density	1.4	g/cm ³ or
Effluent P Concentration	15	mg/L	Depth of Soil	0.7	m or 7,440 kg/ha
Design Life of System	50	yrs	% of Predicted P-sorp. ^[3]	0.5	Decimal 759.1836735 mg/kg

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	898 m ²	Nominated LAA Size	1,350	m ²	
Phosphorus	1,119 m ²	Predicted N Export from LAA	-11.75	kg/year	
		Predicted P Export from LAA	-1.81	kg/year	
		Phosphorus Longevity for LAA	69	Years	
		Minimum Buffer Required for excess nutrient	0	m ²	

PHOSPHORUS BALANCE

STEP 1: Using the nominated LAA Size

Nominated LAA Size	1,350	m ²			
Daily P Load	0.024	kg/day	→ Phosphorus generated over life of system	438	kg
Daily Uptake	0.0110984	kg/day	→ Phosphorus vegetative uptake for life of system	0.150	kg/m ²
Measured p-sorption capacity	0.48314	kg/m ²			
Assumed p-sorption capacity	0.242	kg/m ²	→ Phosphorus adsorbed in 50 years	0.242	kg/m ²
Site P-sorption capacity	326.19	kg	→ Desired Annual P Application Rate	10.575	kg/year
			which equals	0.02897	kg/day
P-load to be sorbed	4.71	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]. Conservative estimate based on work by Geary & Gardner (1996) and Patterson (2002).

[3]. 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.