Greg Alderson & Associates

Chartered Professional Engineers and Scientists

ABN 58 594 160 789

OUR REF: 19313_WW REV E COVER LETTER.DOCX
YOUR REF: DA 10.2021.114.1

The General Manager
Byron Shire Council
PO Box 219
MULLUMBIMBY NSW 2482

9 December 2021

Attention: Environmental Health Officer

Re: 'Request for Further Information' – DA 10.2021.114.1 – Light Industrial development at Lot 10 DP 790360, 467 Federal Drive, Federal.

Dear Sir/Madam,

This letter outlines the response to points 1 to 5 raised in Council's 'Request for Further Information' (RFI) issued on the 30th of August in relation to DA 10.2021.114.1. These five points raised in the RFI all relate to the on-site wastewater management report prepared by this office and submitted with the subject DA. The five points outlined in the RFI are reprinted within this letter, followed by our formal response in red as to how each matter raised has been addressed.

1. *Consistent with Council guidelines for onsite sewage management systems (OSMS), evapotranspiration is the preferred method for managing post treatment nutrients, not infiltration. Council acknowledges that the scale of the proposal substantially impacts the potential for evapotranspiration land application methods; however, other opportunities to either allow sufficient space (reducing the building footprint) to allow for an evapotranspiration area, or to reduce the water budget have not been satisfactorily discussed. Council also notes that the proposed landscaping area is greater that the area proposed for the under carpark land application area.* This is not correct. There is approximately 450m^2 of landscaping area depicted on the plans submitted with the DA. Much of this landscaping area is considered higher risk when considering setbacks to boundaries and buildings. The under-car-park disposal area is 544m^2, being larger than the landscaping area.

   As such, the building footprint should be reduced to provide sufficient space for evapotranspiration fields, and a revised OSMS design is required that allows for: reuse of treated greywater for toilet flushing and landscaping; use of toilets with hand basins that drain to the cistern; and a higher level of nutrient reduction and disinfection of effluent for application to the landscaping. The opportunity to reduce the building footprint and modify the

proposed OSMS should be considered, as should the associated risks with reducing boundary setbacks to adjoining properties for treated effluent application to landscaping. The attached revised (Revision E) OSMS report has been amended to incorporate reuse of treated wastewater for toilet flushing (see Section 3.1, 4.1 & 4.1.1). This toilet reuse can occur following greywater treatment through a higher-grade treatment system to that proposed in the DA submission (see 3.1, 4.1 & 4.1.1 within revised report). It is most likely that a membrane filtration OSMS will be utilised, however the final OSMS will be determined in the Section 68 application. It is possible that a OSMS utilising reverse osmosis or dissolved air flotation may be installed.

With the reuse of treated wastewater for toilet flushing, modelling within Section 3.1 of the attached report shows the daily hydraulic load will decrease from 900L/day down to 585L/day. Despite this reduction the proposed OSMS and disposal area is still sized to manage 900L/day. This is to ensure the OSMS design is robust.

The proponents are not proposing to reduce the building footprint to accommodate an evapotranspiration wastewater disposal area. The attached report demonstrates through scientific methodology including geotechnical investigation, in-situ soil permeability testing and adherence to permeability rates given in AS/NZS 1547:2012 that absorption alone can be relied upon for wastewater disposal, and the proposed disposal area is sized accordingly. This has been supported through peer review by Whitehead & Associates.

2. *The OSMS proposal is supported by a peer review by a qualified third party that refers to another report:*

   "The above report (the report), dated 31 July 2019, Reference 19313_ww.docx along with subsequent Revisions A, dated 5 September 2019 and 8, dated 12 September, have been prepared by Greg Alderson Associates"

   However, the OSMS report submitted is titled 'For: Davgav Pty Ltd Report no: 19313_ww ***Revision D****.docx Date 1 Feb 2'. The peer review does not encompass the submitted report and makes specific references to report revisions A and B only.* The attached OSMS report includes an updated peer review report form Whitehead & Associates relevant to the attached report, being Revision E.

   Please provide details of any changes in the revisions and ensure all referred documents have been submitted in one package. The amended OSMS must also address the following:

3. *Please amend the OSMS report to include any wastewater load from visitors/patrons as only tenants are discussed, and details on access for emptying the liquid trade waste tanks depicted within the report.*
   Visitors and patrons to the light industrial sheds are not permitted to utilise the toilet amenities within the proposed development. Toilet access is to be via lock and key with tenants instructed not to provide toilet access to any visitors

or patrons. Council has constructed public toilets approximately 420m to the south east of the subject site, which visitors and patrons will be directed to use. Despite this, the OSMS has capacity to manage an additional 242 toilet uses per day after staff usage is accounted for as described in Section 3.1 of the attached OSMS report (Revision E). This provides a safety factor if visitors or patrons are given access to utilise the amenities (the lease agreements for the tenants are to stipulate that visitors and patrons are to be directed to the public toilets and not given keys to utilise the on-site amenities).

Regarding access to liquid trade waste tank, Figure 1 highlights the greatest distance between the most distant trade waste tank to a pump out truck access point. It can be seen that the greatest distance a pump out truck will have to reach is 21.5m (including 2.0m depth of tank). This distance is acceptable as Summerland Environmental have confirmed that their pump out trucks have either 30m or 40m length hoses.

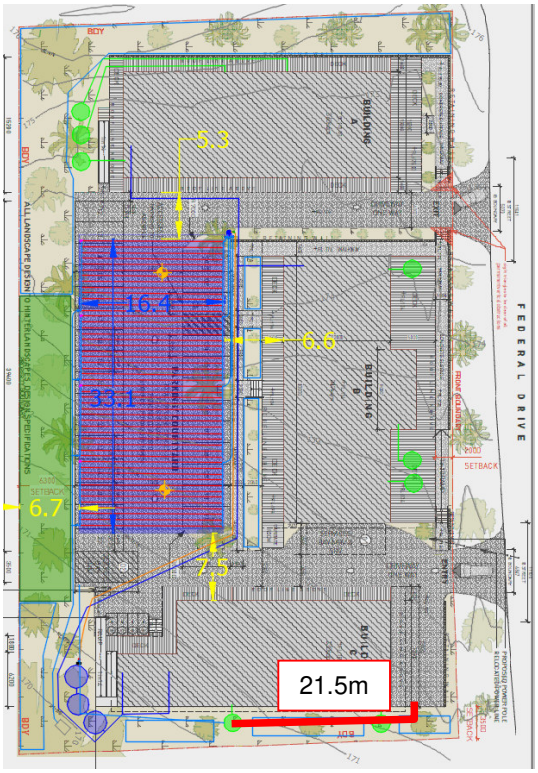


Figure 1. Greatest distance between a trade waste tank and pump out truck access point.

Three tanks within Figure 1 are shown to be installed under decking to the east of building B (middle building). It is proposed that the decking will be constructed with removable hatches to allow access to the tanks. The deck will be required to be engineered to allow the installation of the under-deck tanks.

It must be noted that the final positioning of trade waste tanks will be determined within a Section 68 application pending approval of the subject

DA. What is shown in Figure 1 can be considered a 'worst case' scenario given the number and size of the tanks shown. The tanks depicted in Figure 1 are 2000L volume tanks, which may be reduced in number, size and location within the Section 68 application.

4. *A kitchenette is mentioned in OSMS report but is not shown on building plans. Please confirm if a kitchenette is proposed in the development, and if so, provide amended plans demonstrating its location.* Revised floor plans showing kitchenettes are attached to this letter.

5. *Location of OSMS treatment tanks and some trade waste tanks do not provide ease of access. The location of the OSMS treatment tanks with an aerator operating 18 hours a day is close to three neighbours.* Access to OSMS treatment tanks is not a constraining issue. The distance between the most distant OSMS tank and car park is 25m (including 2m tank depth) which is accessible by a standard pump out truck (See point 3 response).

   The location of the shown OSMS tanks is positioned to receive all wastewater generated on the site under gravity. Positioning the OSMS tanks in the NW corner of the property will mean two OSMS tanks with internal pumps will still be required in the location shown as they will be needed to transfer both greywater & blackwater to the OSMS treatment tanks as gravity flow will not be achieved.

   Figure 2 shows that the location chosen for the OSMS tanks creates a minimum 17.8m setback to the closest neighbouring dwelling. It also shows that if the OSMS tanks were positioned in the NW area of the property they will be a similar distance to a neighbouring dwelling (most likely ≈17m), as indicated by the dimension given on the plan.

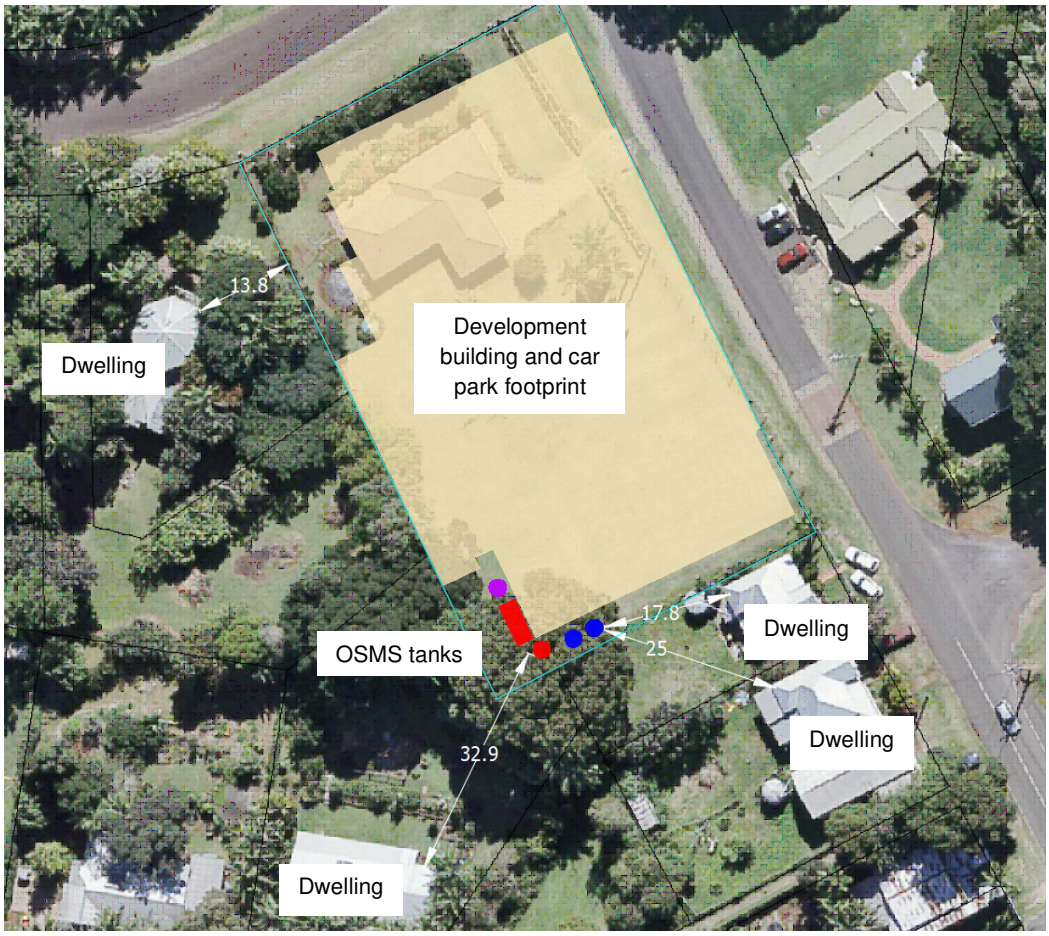


Figure 2. Setbacks between OSMS tanks and neighbouring dwellings.

17.8m is considered an acceptable setback to an OSMS. Domestic OSMS's that utilise aerators and pumps are commonly placed within 17.8m of neighbouring dwellings in village settings. The OSMS nominated within the Section 68 application can be programmed for the aeration and pumping sequences to occur during daylight hours and will be made to be compliant with the NSW EPA *Noise Policy for Industry* (2017). This will be possible as wastewater generation will be during daylight hours matching the developments operational hours.

The OSMS and common trade waste tanks should be relocated on the site to mitigate and minimise any adverse impacts on adjoining landowners. For example, they may be relocated to the NW corner for ease of access and reducing possible noise impacts on a number of neighbours, avoiding heavy vehicles within the site and over the OSMS land application area.

The OSMS and trade waste tanks are not proposed to be relocated from the locations shown in the attached report (see Exhibit No. 2 within the report). Placing tanks in the NW corner of the property will still require two tanks in the location nominated in the attached report. The proposed carparking area has been designed using Ausdrain drainage cells which have a compression strength of 210 tonne/m^2 (See Section 2.6.1 or Appendix C of the attached report), meaning that heavy vehicles can safely travel over the carpark

(subject to structural engineering design). Noise generated from the OSMS tanks will be required to be compliant with the NSW EPA Noise Policy for Industry (2017). The chosen OSMS treatment system will be chosen and details submitted with the Section 68 application.

Please not that the attached OSMS report (Revision E) is for demonstrating wastewater management feasibility only. Detailed Section 68 applications will be required for the OSMS and trade waste systems to be installed. Council will be able to review the final proposed detailed OSMS and trade waste system designs at Section 68 stage.

If you require any further information, please contact our office.

Yours faithfully,
Greg Alderson and Associates

Dylan Brooks
Environmental Consultant

cc: Damian Chapelle (town planner), Gavin Elterman (proponent)

Attachments:
- OSMS report (Revision E dated 9/12/2021)
- Amended floor plans showing kitchenettes within buildings

Whitehead & Associates
Environmental Consultants

Peer Review of On-site Sewage Management Report – Proposed light industrial development at Lot 10 DP 790360, Federal Drive, Federal NSW Report No.: 19313_ww Revision E.docx

The following documents have been received for review:

- Letter from Byron Shire Council, Request for Further Information DA No. 10.2021.114.1, dated 30 August 2021 (4 pages);
- Letter from Greg Alderson Associates responding to the above letter from Byron Shire Council, dated 9 December 2021 (6 pages);
- On-site Sewage Management Report – Proposed light industrial development at Lot 10 DP 790360, Federal Drive, Federal NSW (including Appendix A but no Appendices B-H), prepared by Greg Alderson Associates, dated 9 December 2021 (41 pages);
- Exhibit No.: 2 Possible OSMS Layout, Revision E, dated 9 December 2021 (1 page); and
- Membrane Bioreactor as Alternative to Traditional Activated Sludge Process at Lot 10 DP 790360, Federal Drive, Federal, prepared by Watercore (9 pages).

Earlier versions of the Greg Alderson Associates report (Revisions A and B) have previously been peer reviewed on behalf of Davgav Pty Ltd (Greg Bachmayer), by Joe Whitehead, Principal, Whitehead & Associates Environmental Consultants Pty Ltd.

Comments and suggestions made as part of my review of earlier Revisions of the report have been incorporated into the On-site Sewage Management Report.

This review has been conducted with reference to the following:

- Standards Australia, (2012), AS/NZS1547:2012 *On-site Domestic Wastewater Management.*
- NSW DLG, (1998), Environment & Health Protection Guidelines *On-site Sewage Management for Single Households.*
- Byron Shire Council, (2001), *On-site Sewage Management Strategy.*
- Byron Shire Council, (2004), *Design Guidelines for On-site Sewage Management for Single Households.*
- Byron Shire Council, (2004), OSMS Design model (xls) DM491166-Adopted-body-text-of-Design-Guidelines-for-On-site-Sewage-Management-for-Single-Households.-Adopted-by-Council-30-November-2004 downloaded from Byron Shire Council website 13 August 2019.

This peer review has been undertaken Joe Whitehead, Principal, Whitehead & Associates Environmental Consultants Pty Ltd. I have read the documents in full and referred to the documents listed above.

Letter from Byron Shire Council, Request for Further Information DA No. 10.2021.114.1, dated 30 August 2021

This letter requests further information under the headings of:

- Building Certification;
- Environmental Health;
- Development Engineering; and
- Planning.

Building Certification

1. Council refers to ablution facilities and the occupancy of the buildings.

This review assumes that the occupancy of the buildings will not exceed 30 persons. An allowance of 30 litres/person/day has been made in determining the daily hydraulic load for the wastewater system, for a total of 900 litres/day.

Environmental Health

1. The proposal is for an absorption system, based on design principles outlined in AS/NZS1547:2012. The water budget is minimised by the use of water conserving devices and by making toilet provision just for the site based workforce. The general public will be directed to the nearby public toilets. It is confirmed that the proposed wastewater disposal area is 544m^2 whilst the landscaped area is approximately 450m^2. It is noted that much of the landscaped area is in linear strips along the site boundaries and adjacent to the proposed buildings. The proposal is for separation of greywater and black water with reuse of treated greywater for toilet flushing and treatment to Advanced Secondary standard with disinfection of black water and surplus greywater. The expected quantity of treated effluent for disposal is 585 litres/day. If irrigated at a Design Irrigation Rate (DIR) of 3 mm/day, appropriate for the light clay soils of the site, this would nominally require a land application area of 195m^2. Using the risk assessment outlined in AS/NZS1547:2012 it would be possible to reduce setback/buffer distances to the property boundary to 1.5 metres and to buildings to 2.0 metres, subject to Council approval, but this may still not leave sufficient area for irrigation at the recommended rate. Absorption beds under the proposed car park are proposed as an alternative, with a Design Loading Rate (DLR) of 5 mm/day, which is half of the recommended rate for Secondary treated effluent on the light clay soils. The Council design model identifies a requirement for the following areas: hydraulic load 189m^2, nitrogen load 355m^2 and phosphorus load 21m^2. The proposed area of 544m^2 incorporates in excess of 100% reserve area (not typically required with Secondary treatment) for the hydraulic load and effectively results in a conservative hydraulic application rate (DLR) over the whole area of a little more than 1mm/day. Careful selection of a treatment system which achieves high level of nutrient removal will minimise nutrient loads on the proposed land application area. Council should identify appropriate conditions for the treatment systems.

2. This review is of Revision E of the report dated 9 December 2021 as described above. The main changes to the report are the separation of greywater and blackwater, with

separate treatment systems for the two streams. Treated greywater will be used for toilet flushing and this will reduce the daily hydraulic load for disposal to 585 litres. This will result in a reduced load for application to the proposed land application area which remains at 544m^2. Thus the land application area design is more conservative and the resultant DLR is a little over 1 mm/day, almost one half the minimum DLR recommended for the least favourable soils described in AS/NZS1547:2012 (medium to heavy clays). The proposed DLR is a very low and conservative loading rate.

3. The proposed design does not include any wastewater generated by visitors or patrons. The design provides for wastewater generation by 30 staff at 30 litres/person/day for a total of 900 litres/day. These are values in line with AS/NZS1547:2012 and NSW Health guidelines. It is expected that greywater reuse will account for 35% of the wastewater generated, reducing the volume for disposal to 585 litres/day. The capacity of the treatment system will remain at 900 litres/day. Whilst the nature of operations to be undertaken in the proposed industrial units is not yet known, it is proposed that any trade waste is managed separately by individual trade waste systems separately plumbed to collection wells located at the periphery of the buildings. It is proposed that these will be installed in accordance with Byron Shire's Liquid Trade Waste Guidelines. Council should satisfy itself that appropriate separate internal plumbing has been installed at the construction stage and that the location of the tanks is accessible to pump trucks. Possible locations for the liquid trade waste tanks are shown on the Possible OSMS Layout plan Exhibit No.: 2. Given the constrained nature of the site and the limited capacity of the onsite wastewater system, it is important that no additional liquid trade waste is directed to the onsite wastewater system.

4. No separate kitchenette is shown on the OSMS plan. It is presumed that kitchenettes may be included as part of the individual industrial units and that wastewater generated from them will flow to the proposed onsite wastewater management system. Such wastewater is appropriately included in the 30 litres per person per day allowance made for staff. A revised plan showing the location of the kitchenettes has been prepared.

5. Locations of the OSMS tanks are shown on the Possible OSMS Layout plan in the SW corner of the development. Locations of possible trade waste tanks are also shown. The distance from the farthest treatment or trade waste tank to the nearest location for pump truck access is less than 30 metres. This is within typical distances managed by pump truck operators. 2,000L trade waste tanks are proposed. The proposed wastewater treatment systems are of a similar scale to residential systems. It is noted that aerators on domestic AWTS may operate up to 24 hours per day, often within lesser distance to their respective residences or neighbouring residences than the approximately 17 meters proposed. Thus noise impacts are unlikely to be significantly more than those associated with many residential systems. Noise ratings for OSMS are typically available from manufacturers. Council should condition suitable noise rating requirements. Relocation of the wastewater treatment system to the NW corner of the site would result in a similar separation distance to the nearest residence (~17 metres) and would complicate the wastewater system design by requiring collection wells and macerator pumps to transfer wastewater to the higher location. It would be

preferable to retain a simple gravity fed system with the treatment plant(s) in the SW corner of the development. It is understood that the proposed OSMS land application area will be engineered to carry the weight of a full pump truck, hence off-road access to the OSMS and trade waste tanks is possible.

Development Engineering

1. Any amended traffic plan needs to make adequate provision for pump truck assess to both the wastewater and trade waste systems.

2. The Stormwater Concept Plan needs to make appropriate consideration of the requirements for wastewater management, in particular to ensure that stormwater does not impact upon the operation of the proposed wastewater disposal area.

Planning

1. Reticulated water supply is not available. It is assumed that water supply will be collected on the roofs and supplied from an onsite tank. The sizing of the onsite wastewater system is appropriate for premises with roof tank water supply.

Letter from Greg Alderson Associates responding to the above letter from Byron Shire Council, dated 9 December 2021

The letter provides responses to the questions relating to onsite wastewater matters raised by Council. It clarifies some aspects of the proposal and confirms the basis for the proposed design and system sizing and affirms that the land application area design and sizing is supported by the principles of AS/NZS1547:2012. The proposed land application system is to operate by absorption only with a very low design loading rate of a little over 1 mm/day. This is approximately one-half the lowest loading rate identified in AS/NZS1547:2012, which would be for medium to heavy clay soils, themselves less favourable for onsite wastewater application than the light clay soils of this site.

The letter flags the requirements for clear instruction to be provided to tenants with respect to the non-provision of toilets for the general public and the installation and operation of appropriate trade waste systems and the sizing, location and operation of trade waste pump out tanks. These are areas where it is recommended Council determine appropriate conditions for the approvals to install and operate the systems.

The letter responds to Council's suggestions to locate the wastewater disposal areas around the periphery of the site and to relocate the OSMS to the NW corner of the site. The vegetated strips peripheral to the site are narrow, with limited space constrained by setbacks to the buildings and property boundary. These areas are further constrained by the proposed locations of the trade waste tanks. Given the low DLR adopted and the level of engineering design offered in presenting the alternative absorption bed beneath the more centrally located car park, the proposed land application area represents a more conservative design in terms of DLR, reserve capacity and available buffers to buildings and the property boundary than would irrigation areas around the outer margins of the site. The relocation of the OSMS to the NW corner of the site would preclude gravity drainage to the OSMS and

would necessitate a gravity fed collection well and macerator pump in the SW corner to then transfer to treatment system in the NW corner. This would introduce unnecessary complexity to the design and potentially generate odours which can be avoided by direct gravity feed to the OSMS in the SW corner.

Several matters discussed in the letter are appropriate for Council to condition: acceptable noise levels, trade waste plumbing requirements, and location, sizing and management of the trade waste tanks.

On-site Sewage Management Report – Proposed light industrial development at Lot 10 DP 790360, Federal Drive, Federal NSW (including Appendix A but no Appendices B-H), prepared by Greg Alderson Associates, dated 9 December 2021

I have read the report in full and comment as follows:

- The report revises and updates earlier versions which I have previously reviewed and commented upon.

- No reliance is made on plant growth in the proposed land application area as the proposed system operates by absorption only and will be beneath an engineered car park. The soils have ben appropriately assessed and their characteristics: texture and hydraulic conductivity, indicate that they have a DLR for secondary treated effluent of 10mm/day. The proposed design is based on a DLR of 5mm/day, but by retaining the land application area sizing for a daily hydraulic load of 900 L/day, reducing the daily hydraulic load to 585L/day by greywater recycling and by incorporating the reserve area into the operating area, the effective design loading rate is reduced to a little over 1mm/day. This is a very low loading rate, approximately one-half the lowest rate approved for the least favourable soils (medium-heavy clay) considered by AS/NZS1547:2012, when, in fact, the soils on the site are more favourable light clays. The proposed loading rate is very conservative.

- The land application area has been sized to meet the requirements of the Byron Shire Council water balance model.

- The proposed land application area will be designed and constructed to ensure incident rainfall and stormwater is excluded. Appropriate note of this should be taken in preparation and implementation of the stormwater management plan and stormwater management measures. Stormwater modelling should demonstrate the capacity of the stormwater system to manage the stormwater runoff from the car park/land application area.

- The load bearing capacity of the drainage cells to be used in the land application area is 210 tonnes/m^2, which is sufficient for both use as a car park and for trafficking of a laden pump truck which will be required periodically to empty the OSMS and trade waste tanks.

- Two groundwater bores are located within 250m of the site. These have been appropriately considered and viral die-off modelling undertaken, demonstrating that

setback distances less than 11 metres are required to adequately protect groundwater from any impacts of treated effluent application. I have undertaken comparable die-off modelling which confirms that the results presented in the report are appropriate.

- The report indicates that the treatment system will have surplus capacity, though any additional wastewater treated would increase the load on the land application area. Whilst it is not intended that toilet facilities be utilised by the general public or visitors to the business premises on the site, this additional capacity would ensure that any occasional additional use of facilities was adequately catered for.

- Whilst nutrients are not typically considered limiting in absorption systems, nutrient modelling has been undertaken to demonstrate that the proposed land application area meets the criteria of the Byron Shire Council water balance model. The report flags that a level of phosphorus reduction of 84.7% should be achieved by the selected commercial AWTS. This level of reduction would typically be achieved by chemical dosing. Test data should be provided to confirm that this level of phosphorus reduction can be achieved by the selected system and Council should condition the approval accordingly.

- The report indicates that 53.7% total nitrogen removal is required. It is important to confirm that the stated levels of nitrogen and phosphorus removal can be achieved by one and the same system and that test data is available to confirm this performance. Council should condition this accordingly.

- Appropriate hydraulic design should be completed to demonstrate that even distribution can be achieved over the entire land application area. The system should be clean water tested to demonstrate this even distribution with inspection by Council at the time of testing. Council should condition these as requirements.

- Revised versions of Exhibits 3, 4 and 5 mentioned in Section 4.3 of the report have not been provided for review. I am advised that these appendices have not been amended. I have reviewed and commented on earlier versions previously and those comments still stand.

- Section 2.6.1 indicates that the Ausdrain drainage cells to be used are 50 mm deep. Section 4.5 indicates that the hydraulic overflow sensor height should be set at 200 mm from the base of the drainage cell. As four layers of drainage cells are proposed, this indicates that the sensor height is the top of the upper drainage cell. Given that emergency storage is then limited to the void space in the overlying 100mm sand layer, the appropriate emergency response to deal with the situation where the sensor is triggered should be defined.

- The proposed trade waste management is outlined. The trade waste system is intended to be completely separate from the wastewater management system which is the subject of this review. Nevertheless, it is important to ensure that inadvertent or even deliberate direction of trade waste to the wastewater system is avoided. This will need clear direction on the part of Council to the property owner and managers and tenants and should be conditioned accordingly.

- The report provides clear indication to Council of a number of areas where Council may outline conditions of consent to ensure appropriate actions are taken in the design, construction, operation, maintenance, monitoring and reporting of the OSMS.

- It is recommended that Council identify appropriate conditions of consent for development approval and undertake inspection at relevant stages of installation to ensure that all facets of the proposed design are incorporated.

Exhibit No.: 2 Possible OSMS Layout, Revision E, dated 9 December 2021

This plan accompanies the report and shows the layout of the proposed system.

Membrane Bioreactor as Alternative to Traditional Activated Sludge Process at Lot 10 DP 790360, Federal Drive, Federal, prepared by Watercore

This report describes a membrane bioreactor (MBR) treatment system for possible adoption at the site.

The report does not detail the size of the system but the illustrations are of containerised plants. It should be confirmed that the plant(s) fit in the allocated space shown on the site plan (Exhibit No.: 2).

The report indicates that the plant can achieve some of the requirements of the Australian Guidelines for Water Recycling: Managing Health and Environmental Risk. Council should be satisfied that the necessary requirements for recycled water use for toilet flushing are conditioned.

Section 2 Benefits, indicates that the treatment plant eliminates the need for a disposal area under the car park. This is, in fact, not the case. The need for disposal under the car park remains, though the loading is significantly reduced by the use of recycled water for toilet flushing.

They system appears to be of adequate capacity with an output up to 4kL/day.

The system offers high levels of nutrient removal with TN <5mg/L and TP <1mg/L and with dosing TP down to 0.04 mg/L.

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

Yours sincerely,

G. M. Whitehead

10 January 2022

197 Main Road Cardiff NSW 2285 Australia Telephone + 61 2 4954 4996
Email mail@whiteheadenvironmental.com.au Website www.whiteheadenvironmental.com.au
ABN: 48 091 629 686

On-site Sewage Management Feasibility Assessment

'FED SHEDS'

Proposed light industrial development at Lot 10 DP 790360, Federal Drive, Federal

For: Davgav Pty Ltd
Report no: 19313_ww Revision E.docx
Date: 9-Dec-21

Greg Alderson Associates

Greg Alderson Associates

Contact Information

43 Main Street,
Clunes NSW 2480

Telephone: 02 6629 1552

office@aldersonassociates.com.au
www.aldersonassociates.com.au

Document Information

Project name: Light industrial development

Reference: 19313_ww Revision D.docx

Revision Summary:

Revision A – Amended to incorporate recommendations from Whitehead & Associates following peer review

Revision B – Amended to incorporate further changes from Whitehead & Associates following peer review

Revision C – Incorporate DA architectural plans and amend to 8 units

Revision D – Revised list of potential tenants

Revision E – Response to RFI, Higher treatment OSMS, separation of blackwater/greywater, toilet reuse & Kitchenettes added to floor plans

CONTENTS

1. Introduction

Greg Alderson and Associates have been commissioned by Davgav Pty Ltd to provide an On-Site Sewage Management feasibility report for a proposed mixed-use light industrial development at Lot 10 DP 790360, Federal Drive, Federal. It is proposed that a complex of 8 light industrial units will be constructed on the property within three separate buildings. The following report provides information for the site investigation and the proposed On-Site Sewage Management System (OSMS) that will treat wastewater generated from the toilet & kitchenette amenities within the proposed units.

The final use of each of the industrial units will not be known prior to the design of the OSMS. It is anticipated that potential uses of the units could include allied health services, artisans, digital film production, post production services, florist and design studies. Wastewater treated and disposed of via the OSMS described within this report will be from the staff working out of these units.

1.1 Proposed OSMS

The design of the OSMS is based on treating wastewater generated from toilets and kitchenette facilities within the proposed 8 industrial units. The following will be used for the design of the OSMS:

- The design is for a total of 30 staff members across the development utilising toilet and kitchenette facilities;
- **Water Conserving Devices** to be installed such as 3/4.5L dual flush toilets & aerators on taps;
- Separation of blackwater (toilet) and greywater (hand basin & kitchenettes) into different treatment systems;
- Treated greywater reused for toilet flushing;
- A land application area consisting of manufactured plastic drainage cells installed beneath a sealed carpark.

Wastewater generated from industrial processes (trade waste) within the units is proposed to be collected separate to the OSMS.

2. Site Description

The site is positioned at the junction of Coachwood Court and Federal Drive. There is an existing brick and tile dwelling, water tank & OSMS positioned in the norther area of the property, and this infrastructure would be demolished or removed following the approval of the proposed development. The remainder of the property consist of lawn or gardens. A map showing the location of the subject property is given in Exhibit No. 1 and a photograph showing the main vacant area of the property is shown in Figure 1.

Figure 1. Vacant area of site looking to the south east.

2.1 Land Area

The allotment is 4000m^2 in area.

2.2 Vegetation

There a no large trees present on the property. Some palm trees and garden shrubs are present around the existing dwelling and under the proposed development all this vegetation will be removed and new landscaping will be planted. There is a large Camphor Laurel tree in the neighbor's land adjacent to the southern boundary of the subject site however this tree is not in a location that will impact upon the proposed OSMS.

2.3 Slope

Slope across the entire site is relatively consistent at approximately 8%. Fall is from the north down to the south. A level pad has been cut and filled to accommodate the existing dwelling.

2.4 Soil

Two boreholes to 2.0m depth were excavated within the proposed land application area and the soil profiles characterised in accordance with AS/NZS 1547:2012. Three other bore holes were excavated in other locations on the site but were outside the proposed land application area. Soils were consistent across the boreholes, being red, clay loam krasnozem soils increasing in clay content to form light clay (Category 5) soils by 800 mm depth. No rock, rock floaters or rock fragments were stuck in any of the boreholes. Preceding weather conditions were dry at the time these boreholes

were excavated, and the soils were slightly moist from a depth of 300mm to the extent of the borehole.

Tables 1 & 2 present borelogs of the soils at the site from the boreholes excavated by staff of this office in the proposed land application area. Samples were collected at depths of 0.5m, 1.0m, 1.5m & 2.0m within each borehole and were tested for pH, dispersiveness (modified Emerson Aggregate test) and texture (hand bolus). Photos of these physical tests are attached in Appendix A.

Table 1. Borelog of soil excavated in bore hole 1.

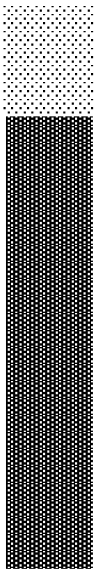
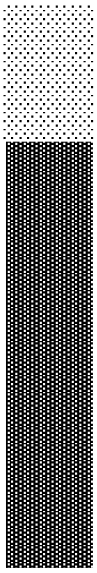
Horizon	Depth (mm)	Horizon	Texture	Structure	Colour	Soil Category	Coarse Fragments	pH	Dispersive Class
	0	A – top soil	Clay loam	Strong – Peds distinct in undisturbed soil	Red	4	None observed in borehole		
	400	B – sub soil	Light clay to extent of borehole	Moderate – Peds well formed and evident when disturbed but not distinct in undisturbed soil		5			
	500							4.5-5	Not tested
	1000				Brown at 1100 mm depth			4.5-5	Slaking – no dispersion
	1500							4.5-5	Slaking – no dispersion
	2000							4.5-5	Slaking – no dispersion

Table 2. Borelog of soil excavated in bore hole 2.

Horizon	Depth (mm)	Horizon	Texture	Structure	Colour	Soil Category	Coarse Fragments	pH	Dispersive Class
	0	A – top soil	Clay loam	Strong – Peds distinct in undisturbed soil	Red	4	None observed in borehole		
	500	B – sub soil	Light clay to extent of borehole	Moderate – Peds well formed and evident when disturbed but not distinct in undisturbed soil	Red	5		4.5-5	Not tested
	1000							5	Slaking – no dispersion
	1500							5	Slaking – no dispersion
	2000							5	Slaking – no dispersion

Morand (1994) shows that the soil type of the site is of the 'Wollongbar Residual Landscape' on the Soil Conservation Service 1:100,000 Soil Landscape Map. The soil encountered in the investigation would support this description of soils in the Wollongbar Residual Landscape, however the boundary with the Rosebank Erosional Landscape is close to the site and there may be some characteristics of this soil landscape at areas of the subject site. The following is a summary of the description of this soil landscape in Morand (1994).

Soil Landscape:	Wollongbar Soil Landscape
Soils:	Mostly deep (>200 cm), well drained Krasnozems with shallower stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines
Geology:	Lamington volcanics: Lismore Basalts – Tertiary basalts, with bore and minor agglomerate
Limitations:	Extremely acid soils with high aluminium toxicity potential, low available water holding capacity, moderate to high erodibility and localised stoniness
Permeability:	slow to moderate.

A geotechnical investigation by a geotechnical engineer was also undertaken at the site. This geotechnical report is attached to this report as Appendix B. As detailed in the report, four boreholes were excavated across the site down to a depth of 3.0m, with no rock being struck in any borehole and soils presenting consistently between all boreholes.

Table 3 presents an assessment for the proposed disposal system in accordance with the *Environment and Health Protection Guideline On-site Sewage Management for Single Households* (Department of Local Government, Environment Protection Authority, Department of Health, Department of Land & Water Conservation, Department of Urban Affairs & Planning, 1998).

Table 3: Soil Assessment for Wastewater Disposal in accordance to EHPG.

SOIL FEATURE	COMMENT	LIMITATION RATING		
		Minor	Moderate	Major
DEPTH OF SOIL	It is estimated that the soil is greater than 3.0m in depth	✓		
DEPTH TO HIGH EPISODIC/ SEASONAL WATERTABLE	The water table was not intersected during borehole tests and no springs or other water discharges were observed. An allowance of 3.0 m to the watertable was used in order to size the land application area based of phosphorous movements	✓		
SOIL PERMEABILITY	The sites soils were light clays which are expected to have moderate permeability.		✓	
COARSE FRAGMENTS	None observed across boreholes	✓		
pH	Soil pH has been tested and is between 4.5 – 5 throughout the soil profiles		✓ with addition of lime	
ELECTRICAL CONDUCTIVITY (dS/m)	Morand (1994) states that the Wollongbar soil landscape has a very low electrical conductivity, there was no evidence of vegetation being affected by salt	✓		
PHOSPHOROUS SORPTION (kg/ha)	Morand (1994) states that the Wollongbar soil landscape has a very high phosphorous sorption rate of greater than 600mg/kg which is equivalent to greater than 10000kg/ha/year. 10000kg/ha/year was used for the design of the land application area	✓		
MODIFIED EMERSON AGGREGATE TEST	Emerson aggregate testing using the modified aggregate test shows all soils are slaking but not dispersive	✓		

Overall, the EHPG (1998) would class the soil as being suitable for disposal of wastewater.

2.4.1 Improvements to soil

Increased acidity affects cation exchange capacity and can lead to deficiencies in calcium and magnesium while mobilising aluminium, which is toxic to plant growth. Lime can be added to the soil profile when preparing the area for disposal to increase the pH to a range between 5.0-6.0, which will enable plants to take up nutrients, which will be within the wastewater.

Agricultural lime with a superfine texture and neutralising value of >95% is to be spread into the land application area. The rate of application is to be 1.25 kg/m^2 when spreading the aglime over the exposed base of the land application area. The Aglime is also to be mixed into the sand media within the disposal field at a rate of 12.5 kg/m^3. These liming rates have been calculated using the Cation Exchange Capacities for the Wollongbar soil landscape given in Morand (1994), being rounded to 15.0 me/100 grams, and the liming rate table (Table 3) given in Fenton (2003). The application of lime will reduce the degradation within the soil structure from sodium application,

which is contained in the wastewater. This will improve the long-term permeability of the receiving soils within the land application area.

2.4.2 Permeability rates

Site specific permeability rates have been generated using site specific data and Table L1 of AS/NZS 1547:2012. Site data was gathered by the undertaking of permeability testing on the site by geotechnical engineers using the Talsma-Hallam permeameter with modifications. This is the method described within Appendix G of AS/NZS 1547:2012 for measuring soil permeability.

Permeability testing was undertaken at depths of 1m, 2m and where possible 3m. Within the attached geotechnical report (Appendix B) full results are given in metres/second, however these results have been converted to mm/day to correspond to AS/NZS 1547:2012.

Following the conversion of the permeability rates to mm/day, a Long Term Acceptance Rate (LTAR) was calculated using the soil permeability to LTAR rate table given in Section 3.5.1.1 of AS 1547 – 1994. Table 4 below presents the permeability results and LTAR conversion for the data collected at the site. It also includes a comparison to the LTAR's given for light clay soils with secondary treatment for trenches & beds within Table L1 of AS/NZS 1547:2012.

Table 4: interpretation of permeability results from geotechnical report.

Borehole No. & Depth of test (m)	Permeability rate from Geotechnical report (m/sec)	Permeability rate converted to mm/day	Equivalent LTAR (mm/day) derived from AS 1547 - 1994	Comparable LTAR (mm/day) from table L1 in AS/NZS 1547: 2012
BH1 – 1m	$6.5x10^{-7}$	56.16	10.5	12
BH1 – 2m	$5.9x10^{-7}$	50.98	10	10
BH1 – 3m	$2.8x10^{-6}$	241.92	18	10

Using the LTAR's calculated above, a Design Loading Rate (DLR) is calculated for using in the design of the OSMS. It is considered that 10 mm/day could be used for the soils at the site, however as the proposed disposal field will involve some compaction of the soils as part of the construction of the drainage cell area a more conservative value is recommended as the DLR.

To provide a robust design a DLR of **5mm/day** will be used. This DLR is consistent with Category 5 moderately structured light clays as given in Table L1 of AS/NZS 1547:2012.

This DLR will allow for some loss of permeability due to compaction of the land application area and will also provide a robust design as the nature of the proposed disposal method will not be able to buffer inadequate permeability rates.

2.5 Environment & Health Risk Assessment

The following (Table 5) is an environment and health risk assessment in accordance with the policy for *Design Guidelines for On-Site Sewage Management Systems* Byron Shire Council (December, 2004) and the *Environment and Health Protection Guideline On-site Sewage Management for Single Households* (DLG *et. al*, 1998).

Table 5: Environment and Health Risk Assessment for Proposed Land application area

SITE FEATURE	LIMITATION MINOR	MODERATE	MAJOR	REASONING
FLOOD POTENTIAL	✓			The land of the proposed land application areas is not subject to flooding. The treatment & land application systems are both above the 1:100 year flood level.
SOIL TYPE		✓		Light clays which have moderate permeability.
EXPOSURE	✓			Exposure to sun and wind is high. Due to the style of proposed disposal sub exposure is not a critical design factor.
SLOPE %	✓			Approximately 8% which is suitable for absorption systems.
LANDFORM	✓			Gently consistently sloped hill crest/minor ridgeline area.
RUN-ON & UPSLOPE SEEPAGE		✓		Upslope seepage is an issue that needs addressing to prevent ingress into the land application area. This drainage will need to be designed by a civil engineer as part of the Section 68 application. Run-on stormwater will be directed away by constructed catch drains
EROSION POTENTIAL	✓			No signs of erosion present in land application areas. Krasnozem soils as found in the land application area are known for not being dispersive and maintaining soil structure.
SUBSOIL DRAINAGE	✓			No visible signs of subsoil dampness in the proposed land application area.
SITE DRAINAGE	✓			Due to permeable soils and gentle slopes surface drainage is not considered to be an issue. There was no evidence of damp soils during the site investigation.
LAND FILLING	✓			Minor fill from cut & filled house pad however this is minor and will not affect wastewater disposal as it will positioned below the fill.
BUFFER DISTANCE		✓		There is a registered groundwater bore within the set 250m buffer to the proposed land application area. Buffers to all water courses & property boundaries are achieved. Discussion of the bore is in Section 2.6.3.
LAND AVAILABLE FOR APPLICATION AREA			✓	Due to the proposed development footprint covering the site, the wastewater land application area is proposed to be located under a sealed car park within the property.
ROCKS AND ROCK OUTCROPS	✓			None observed on-site or in boreholes.
GEOLOGY/REGOLITH	✓			Stable geology. Lamington volcanics: Lismore Basalts – Tertiary basalts, with bore and minor agglomerate (Morand, 1994)

2.6 Site Constraints & Proposed Best Practice

Table 5 in Section 2.5 identifies constraints to wastewater management & disposal that are present on the site. The constraint of greatest concern is the absence of suitable area for a conventional OSMS disposal system. There are also two groundwater bores located within 250m of the proposed OSMS land application area. The constraints identified in Tables 3 & 5.

2.6.1 Land application area

To provide a development that meets the project criteria of the developers, the entire site footprint is used for accommodating building, carparking and stormwater management areas. Therefore, an innovative approach to wastewater disposal is being proposed for this development. It is proposed that a land application area consisting of plastic drainage cells will be constructed beneath a sealed car park.

The base of the land application area will be permeable and used for the wastewater infiltration area. The walls and top of the land application area will be sealed with a membrane and concrete car park to prevent the ingress of rainwater & stormwater into the land application area, which would take up some of the infiltration capacity of the soil. This principle is the same as that commonly used in stormwater management in the form of stormwater infiltration cells.

It is proposed that the 50mm drainage cells manufactured by Ausdrain will be utilized in the land application area. These cells are rated to handle 210 tonnes/m^2 and can be laid to incorporate 50mm PVC pipes between cells. It is proposed that dripper lines within drilled 50mm PVC pipes will be installed within the land application area. Exhibit No 3 & 4 give indicative construction details for the land application area however as part of the Section 68 application a design from a civil engineer will need to be provided. Information on the Ausdrain 50mm drainage cells as attached in Appendix C.

In principle the proposed wastewater infiltration design is proposed to replace the soils natural ability to absorb rainfall. Federal has an approximate annual rainfall of 1800 mm/year (Byron Light house mean rainfall 1737mm/year) (Bureau of Meteorology, 2019) which equates to 4.9mm/day. It is proposed that in sealing the land application area off from rain & stormwater, the soils natural ability to absorb 4.9mm/day will be replaced by the controlled loading of wastewater at 5mm/day (actual DLR will be closer to 1.7mm/day when factoring in actual size of land application area).

It is acknowledged that the key concern with this methodology is that unlike rainwater, wastewater contains constituents that reduce soil permeability with time of application. This issue is being addressed by the following actions:

- treatment of the wastewater to an advanced secondary standard,
- Dosing of the land application area with lime to reduce the soil degradation effect from sodium within the wastewater.

- Having a land application area sized on nutrients rather than hydraulic requirements which also includes a 100% reserve area, meaning that the true DLR will be closer to 1.7mm/day when 900 L/day of wastewater is produced.

2.6.2 Stormwater management

Potential stormwater ingress into the land application area is a concern. Floodworks have prepared a stormwater management design for the proposed development. Appendix D includes the proposed stormwater management plan which shows that surface waters will be shed off and around the land application area and into a sealed bioretention basin. This bioretention based will not allow stormwater infiltration into the land application area as its based is sealed. From the bioretention basin the stormwater enters a pipe where it is taken off-site. This method of stormwater management is suitable for protecting the land application area from stormwater ingress.

2.6.3 Bores

Point 3 within Section 5.1.6 of Byron Shire Council's *Design Guidelines for On-site Sewage Management for Single Households* (2004) states that a 'minimum buffer of 250 metres to downstream or cross-gradient domestic groundwater well, and at least 50 m from upstream groundwater well' is to be achieved. Two boreholes are within 250m of the proposed disposal field, however one of these (GW301413.1.1) bores is located 100m to the north east across gradient and therefore is not within the 50m setback in Council's strategy (2004).

The other bore (GW070327.1.1) is located approximately 110m south of the proposed land application area. Council's policy is that a 250m buffer is required between groundwater bores and wastewater land application areas, however a scientific approach can be used to determine if the actual separation distance proposed is sufficient and will not lead to contamination of the water drawn from the bore. The 'Estimate of the Setback Distance' from the following equation as sourced from Cromer, Gardner & Beavers (2001) is used to determine if the proposed encroachment is suitable and will not cause a health risk to the water drawn from the bore.

There are two parts to this equation. The 'radius of influence' is calculated, which is the lineal distance from which the bore draws groundwater from. This distance is added to the 'setback distance', which is the distance a virus can travel from the wastewater land application area, enter the groundwater and travel within an aquifer.

<u>The Radius of Influence</u>

This represents the radius of influence a bore exerts on the water table. It is calculated using the following equation:

r = 1.5[(KHt/S)^0.5]

Where:

r = radius of influence in metres
K = Saturated hydraulic conductivity (permeability) of the soil in m/day
H = Depth of bore and distance below ground level in meters
t = Pumping time in days
S = Specific yield as a fraction

The equation values of this site are as follows:

K Permeability = 0.5 m/day (used highest indicative permeability rate for strongly structed light clay from Table L1 in AS/NZS 1547:2012)
H Thickness of water = 2.0 m (considered conservative as well is 4m deep in red volcanic soil over basalt)
S Specified yield = 0.03 % for clay (Davis & Cornwell, 1998)
t Time pumped = 1 days (t)

However, prior to calculating the radius of influence the following equation must be satisfied:

t = (Kt)/(SH) >= 1

Radius of Influence of a Bore

Where: $r = 1.5[(KHt/S)^{0.5}]$

Which is reasonably valid for t=Kt/SH>= 1.0
(Kt)/(SH) = 8.3

As this equation is greater than 1, the radius of influence can then be calculated:

$r = 1.5[(0.5*2*1/0.03)^{0.5}]$

Radius of Influence 8.7 m

Calculation of setback distance
This distance represents the distance effluent travels down into and across the water table before its viral count is reduced to the level recommended by the World Health Organisation (WHO).

The calculation to determine this distance is seen below.

Dg = (t – dv.(P/K)) / (P/(K.i))

Where:

Dg = required setback distance

t = time (days) for viral die off to occur in soil
dv = distance wastewater travels to reach groundwater
P = Effective porosity of soil
K = Saturated hydraulic conductivity (permeability) of soil
i = groundwater gradient

The equation values of this site are as follows:

t = 25.1 days (magnitude of 3 (for secondary treatment) and temperature of 14°C)
dv = 5m (assumed from 3m boreholes not detecting groundwater in the subject site)
P = 0.4 (clay)
K = 0.5 m/day (used highest indicative permeability rate for strongly structed light clay from Table L1 in AS/NZS 1547:2012
i = 0.08 (represents cross gradient between land application area & bore)

Therefore:

Dg = (25.1 – 5.(0.4/0.5)) / (0.4/(0.5*0.08))

According to the viral setback distance equation the setback distance required is 2.11 m.

The combined setback distance required between the bore and the land application area is **8.8 m**. As there is approximately 110 m existing between the proposed OSMS disposal field and this bore it is considered that the OSMS does not pose an unacceptable risk to the bores water quality. A copy of the Groundwater Works Summary for this bore is attached as Appendix D.

3. Design Parameters of OSMS

The parameters used for designing the OSMS are described in this section. All wastewater to be treated within the OSMS is to be domestic in nature, being from the toilet and kitchenette amenities serving the staff within the units. Water saving fixtures and treated wastewater reuse through the toilets is also proposed to reduce the hydraulic loading placed on the OSMS.

3.1 Predicted Hydraulic Loading

Predicted hydraulic loading per person is based on values given in AS/NZS 1547:2012. Table H4 within Appendix H of AS/NZS 1547:2012 gives a design flow of **30 L/person/day** for staff in rural factories or shopping centers utilizing on-site roof water tank supply. This loading will be used for sizing the OSMS.

Number of staff within the entire light industrial development is calculated as follows:

- Seven units allowing for 4 staff members = 28 staff

- One unit allowing for 2 staff members = 2 staff

Therefore, a total of 30 staff are designed for giving a total hydraulic loading of:
30 staff * 30L/person/day = **900L/day.**

This design load rate is theoretical and based off the most relevant standards. When considering treated wastewater reuse through toilet flushing, the actual hydraulic wastewater loading has been calculated to be 35% less, being 585L/day. This is based on the following calculations and assumptions:

Each staff member assumed to use toilet 3 times in a working day. Further to this, it is assumed that two of those flushes will be half flush (3L) and one toilet usage will be full flush (4.5L). Therefore, total water usage from toilets per staff member is calculated as:

(2 flushes * 3L) + (1 flush * 4.5L) = 10.5L of toilet flushing water/person/day

If this 10.5L is supplied by treated wastewater, this means that this volume of water is not entering the disposal area. When multiplied by 30 staff this equates to 315L not entering the wastewater disposal area, but rather instead being diverted to toilet reuse. Therefore, the remaining volume of wastewater being diverted to the disposal area will be:

900L – 315L = 585 L/day.

A treatment system to manage 900L a day is still proposed. The disposal area will still be designed to manage 900L/day to ensure the design is robust and incorporates a safety factor of 35%.

This safety factor will allow for any potential toilet use by customers to the development. It is reiterated that under no circumstances should the amenities serving the development be available to customers, but in the event that it was to happen, the safety factor allows for an additional 242 toilet uses per day (based on flushing water being recycled and 1.3L of water being generated from handwashing (1L) and urine (0.3L)).

3.2 Predicted Nutrient Loading

The main nutrients of concern in the OSMS are nitrogen and phosphorus. Nutrient loadings are based on the values given in the *Environment and Health Protection Guideline On-site Sewage Management for Single Households* (DLG *et. al*, 1998). The calculated loadings and treatment levels for these nutrients are given in the following sections.

3.2.1 Total Nitrogen

Total Nitrogen (TN) loadings have been calculated using the highest range of TN loadings for untreated domestic wastewater from Table 9 of *Environment and Health Protection Guideline On-site Sewage Management for Single Households* (DLG *et. al*, 1998). This value is 100 mg/L. The theoretical total loading of TN placed on the OSMS is calculated using the predicted hydraulic loading calculated in Section 3.1 using the following equation:

100 mg/L * 900 L/day = 90,000 mg/day
= 0.09 kg/day

It is anticipated that as a general rule the businesses utilizing the units would be open 6 days a week, 52 weeks of the year. This equates to 312 business days. This then can be used to calculate the annual TN loading as follows:

312 days * 0.09 kg/day = 28 .08 kg/TN/year

It is proposed that a commercial wastewater treatment plant capable of providing advanced secondary treatment will be installed. This will most likely be in the form of a membrane filtration unit being utilized, however it could also be in the form of a Dissolved Air Flotation (DAF) system, reverse osmosis system or an activated sludge system. The chosen level of TN reduction to be used for modelling the required disposal area is 54% as this equates to a typical TN reduction provided by a commercial Aerated Wastewater Treatment System (AWTS).

3.2.2 Total Phosphorus

Total Phosphorus (TP) loadings have been calculated using the highest range of TP loadings for untreated domestic wastewater from Table 9 of *Environment and Health Protection Guideline On-site Sewage Management for Single Households* (DLG *et. al*, 1998). This value is 25 mg/L. The theoretical total loading of TP placed on the OSMS is calculated using the predicted hydraulic loading calculated in Section 3.1 using the following equation:

25 mg/L * 900 L/day = 22,500 mg/day
= 0.0225 kg/day

It is anticipated that as a general rule the businesses utilizing the units would be open 6 days a week, 52 weeks of the year. This equates to 312 business days. This then can be used to calculate the annual TP loading as follows:

312 days * 0.0225 kg/day = 7.02 kg/TP/year

It is proposed that a commercial wastewater treatment plant capable of providing advanced secondary treatment will be installed. This will most likely be in the form of a membrane filtration unit being utilized, however it could also be in the form of a Dissolved Air Flotation (DAF) system, reverse osmosis system or an activated sludge

system. The chosen level of TP reduction to be used for modelling the required disposal area is 84.7% as this equates to a typical TP reduction provided by a commercial Aerated Wastewater Treatment System (AWTS).

To model this TP reduction within the modelled treatment system the following equation is used to determine post treatment TP loading:

7.02 kg/TP/year – (7.02 kg/TP/year *0.847) = 1.074 kg/TP/year post treatment.

This reduced TP value has been entered into cell D11 of Council design model for sizing of the required land application area.

3.3 Land application area Required

This section investigates the land application area required based on the predicted hydraulic and nutrient loadings from the proposed development, and environmental factors which influence the design. In order to ascertain the size of the land application area, the model within the Byron Shire Council Design Guidelines for On-site Sewage Management for Single Households was used (referred to as 'the model') with the hydraulic and nutrient parameters calculated in this report used in the modelling.

It is acknowledged that this model was designed for single domestic households. The principles and calculations used in the model for sizing land application areas are applicable to the proposed wastewater scenario provided the model is modified to reflect what is proposed particularly as water balancing is undertaken within the model using relevant local rainfall data. This model has been modified to reflect the proposed situation as follows:

- 1 person (hydraulic and nutrient values adjusted to match proposed loadings);
- Land area of 4000m²;
- Buffers to water bodies met;
- Daily effluent flow per person modified to 900 L/day in cell D7;
- 28.08 kg/person/year of TN entered into cell D8;
- 1.07 kg/person/year of TP entered into cell D11;
- Phosphorus uptake by plants changed to 0.00 kg/ha/yr in cell B12;
- Nitrogen plant uptake changed to 0.00 kg/yr in cell D12;
- AWTS chosen as the treatment system;
- Nitrogen loss in AWTS set at 53.7% (rounds to 54%) in cell D9;
- 3m depth to water table;
- Red basaltic Soils & light clay moderate structure;
- Level bed land application area;
- Specific crop coefficient changed to 0.00 in cell B20;
- Percentage of effective rainfall reduced to 5% in cell B21 to reflect sealed land application area;
- Percolation rate changed to 5mm/day in cell B22;
- SSI land application.

The land application areas required for the hydraulic and nutrient loadings based on Council's model are:

Nitrogen: 355 m^2
Hydraulics: 189 m^2
Phosphorus: 21 m^2

A copy of the Design model is attached to this report as Appendix F.

To check on the calculated hydraulic area using Council's model a simple calculation can by undertaken by dividing the daily hydraulic loading by the DLR, as the DLR equates to L/day.

900 L / 5 mm/day = 180m^2 of land application area for hydraulics.

This is comparable to the 189m^2 of hydraulic land application area calculated using Council's design model.

As nitrogen was the limiting factor in the sizing of the land application area, a land application area of 355m^2 will be provided. In addition to this, a **100% reserve area** based on hydraulic loading will also be incorporated into the land application area. As the hydraulic area was calculated to be 189m^2 a total land application area of **544m^2** will be provided.

Due to the nature of construction proposed for the land application area it is proposed that the reserve area will be constructed concurrently with the primary disposal field. Section 5.5.3.4 of AS/NZS 1547:2012 allows for variations in how the reserve area is provided and therefore the proposed inclusion of the reserve area into the construction of the primary land application area is considered acceptable.

4. Construction of OSMS

The construction details of the various OSMS components are discussed in this Section. It is noted that the components described within this section of the report are for feasibility purposes only. The actual treatment system to be utilised will be nominated within the Section 68 application, which Council will review prior to issuing any Section 68 approvals.

4.1 Treatment Systems

The NSW Health Advisory Note 4 – January 2017 '*Recommended Final Uses of Effluent based on the Type of Treatment'* outlines the level of treatment required for treated wastewater to be reused through toilet flushing. This document notes that greywater may be used for toilet flushing and washing machines provided the following treatment standards are met:

- BOD < 10 mg/L

- TSS < 10 mg/L
- E. coli <10 cfu/100mL

This level of treatment is classed as 'Advanced Secondary Treatment with Disinfection'. It is proposed that two treatment systems will be installed on the site, one for treating grey water (from handbasins & kitchenettes) for reuse through toilet flushing and another for treatment toilet black water.

4.1.1 Greywater treatment system

All drains from staff kitchenette and handbasin facilities is to be directed into a separate greywater treatment system. Based on calculations given in Section 3.1, the expected flows into the grey water treatment system will be 585 L/day (30L/person day minus 10.5 L for toilet flushing, multiplied by 30 staff members). The demand for treated greywater for toilet flushing will be 315 L/day (10.5L/person for flushing multiplied by 30 staff members) meaning that excess treated greywater (270L/day) is to be pumped to the disposal area. As a contingency in the event that not enough greywater is generated to meet the toilet flushing requirements, the toilet flushing plumbing will require a dual connection to the rainwater tank source. These plumbing details are to be outlined in a Section 68 application.

It is proposed that a septic tank will be installed prior to the greywater treatment system to provide the following functions:

- Act as grease trap for any fats & oils poured down the handbasins;
- Act as buffer to the treatment system if any paints, solvents, antibiotics or other harmful chemicals were poured down the handbasins;
- Reduce BOD & suspended solids prior to the nominated treatment system.

Table J1 within AS/NZS 1547:2012 gives all-waste septic tank operational capacities. A design flow of under 1000 L/day requires a tank capacity of 3000 L. This tank is to have an outlet filter installed.

All wastewater generated from handwashing & kitchenette facilities within the proposed unit development is to be directed into this septic tank.

Following the septic tank, greywater will enter into a treatment system providing advanced secondary treatment with disinfection. An example of such a unit is provided in Appendix G, however the exact treatment system will be determined for the Section 68 application.

4.1.2 Blackwater treatment system

Based on the calculations given in Section 3.1, the anticipated hydraulic loading coming from toilet flushing will be 315 L/day.

It is proposed that a septic tank will be installed prior to the blackwater treatment system to provide the following functions:

- Act as buffer to the treatment system if any paints, solvents, antibiotics or other harmful chemicals are flushed down the toilets;
- Reduce BOD & suspended solids prior to the nominated treatment system.

Table J1 within AS/NZS 1547:2012 gives all-waste septic tank operational capacities. A design flow of under 1000 L/day requires a tank capacity of 3000 L. This tank is to have an outlet filter installed. All wastewater generated from toilets within the proposed unit development is to be directed into this septic tank.

All wastewater from the 3000 L septic tank is to flow into an AWTS for further treatment. As stated, an AWTS providing advanced secondary treatment to a standard of 53.7% nitrogen reduction is required. A Taylex ABS AWTS could to be installed to provide this level of treatment, however the final blackwater treatment system chosen will be detailed within the Section 68 application. These AWTS units are fitted with high water alarms as standard. Details of this particular AWTS is provided in Appendix H.

4.2 Balancing tank

A 10,000L balancing tank is to be installed after the black & greywater treatment systems. This tank will allow for even daily hydraulic loads to be pumped to the land application area in a controlled manor. The wastewater is to be pumped to the land application area in 225L doses at intervals determined by analysing water usage data for the development. This balancing tank is to have a high water audible/visual alarm fitted as well as a low water level cut off float to ensure that the pump doesn't operate dry.

4.3 Drainage Cell Land application area

It is proposed that the land application area will consist of drainage cells beneath a sealed car park. It is proposed that 50mm drainage cells manufactured by Ausdrain will be utilised for constructing the land application area. The final design of the land application area is to be undertaken by a civil engineer in concurrence within the design requirements of the Ausdrain 50mm drainage cells. Some key principles to be followed in the design are:

- Having a sealed land application area preventing rainwater from entering;
- Be constructed to a standard suitable for accommodating heavy vehicle loadings without crushing pipes & cells or compacting the base of the land application area;
- Having pressure dosed irrigation lines installed through the land application area to provide even distribution throughout the entire land application area;
- Having a system of curbs within the land application area to prevent wastewater concentrating at low points. The land application area is also to be level.

Details of the conceptual land application area are attached to this report. The following Exhibits are attached:

- Exhibit No. 2 – Site plan showing footprint of land application area;
- Exhibit No. 3 – Plan showing indicative cross section of the land application area;
- Exhibit No. 4 – Detail plan showing design requirement of the disposal cells;
- Exhibit No. 5 – Hydraulic design.

4.4 Hydraulic Design

A hydraulic design for the irrigation system has been included in Exhibit No. 5. This design will need to be revised and resubmitted to Council within the Section 68 application to incorporate any design changes that may result following the detailed design of the drainage area and carpark by an engineer.

4.5 Contingencies within OSMS

Due to the innovative disposal method proposed within this OSMS it is considered that robust contingencies are to be provided in case of system failure. This allows for the certifying authority to have confidence in the proposed concept and will mitigate risk of adverse performance.

With the chosen grey and blackwater treatment systems there will be automated systems for alerting of issues or failures. Fully automated treatment systems are available, such as the example given in Appendix G. This means that any blockages or malfunctions are reported instantaneously to both property managers and the service agent. This also applies to the blackwater treatment example given in Appendix H, which has an alarm system that can be linked to send a message to the property manager & service agent in the event of a failure in the system. High-water alarms can be fitted as standard to all OSMS tanks to provide a visual/audible alarm to notify of a high-water level within the tanks.

Within the drainage cell land application area, it is proposed that high water sensors are to be fitted. These sensors are to fitted within each of the irrigation cells and are to be positioned within the drainage cell to allow for some reserve area in the event of hydraulic overload. This sensor height is recommended as 200mm from the base of the drainage cell (see Exhibit No. 3 & 4). Due to the size of the land application area, there will be approximately 40 days of emergency storage within the drainage cells (based on 900 L/day hydraulic loading). It is proposed that suitable inspection openings will be included in the land application area design to allow for inspections and pump-outs.

5. Configuration of Plumbing within Industrial Units

5.1 Trade Waste

Internal plumbing within the industrial units is to allow for the separation of trade waste from wastewater to be treated within the proposed OSMS. Byron Shire Council's Liquid Trade Waste Guidelines define liquid trade waste as '*…all liquid waste other than sewage of a domestic nature…*' which excludes '*toilet, hand wash basin*, shower and bath wastes derived from all the premises and activities mentioned above*'. The asterisk on hand washing basins refers to hand washing for personal hygiene only. Therefore, the only wastewater that is to enter the proposed OSMS is that from toilets & handwashing, but it is considered that wastewater generated from staff kitchenettes can also enter the OSMS as it is domestic in nature. Plumbing between toilets, hand basins and kitchenette facilities are to be separate from floor drains and sinks used for commercial or industrial purposes, with suitable signage provided showing which sinks are for trade waste.

Any wastewater generated from business/commercial activities is to be plumbed to a trade waste system separate from the OSMS. It is proposed that each unit will have its own trade waste sinks and floor drains connected to a tank fitted with a high-water alarm that is to be linked to the property manager so appropriate pump out can be organised and charged to the relevant business operator. Exhibit No. 2 shows the possible locations of the trade waste tanks which will allow access for pump out trucks, however final tank volumes, number of tanks and locations is to be determined in a Section 68 application.

Byron Shire Council's Liquid Trade Waste Guidelines provide discharge quality & volume parameters. Every prospective tenant should be briefed on the trade waste requirements and they are to confirm that their proposed use of an industrial unit will not exceed the quality & volume parameters outlined in Council's Liquid Trade Waste Guidelines.

5.2 Amenities Within Industrial Units

To assist in minimising hydraulic loads generated from the staff toilet and Kitchenette amenities within the industrial units it is proposed that the following water saving amenities need to be installed:

- 4-star WELS rated cisterns for all toilets (4.5/3L dual flush toilets),
- 6-star WELS rated taps.

5.2.1 Access to toilets

It is proposed that toilet access will be by key only. Tennent's within the units are to be supplied keys for the toilets for staff use only.

6. Maintenance of OSMS

A detailed maintenance program is to be submitted with the Section 68 application following the approval of the proposed development. The maintenance program is to outline the maintenance actions needed for the septic tank, AWTS and drainage cell land application area.

7. Risk Assessment

There are elements of this proposed OSMS design that are innovative. In addition to the non-standard design features, the OSMS is bordered by sensitive receptors such as dwellings, a bore, stormwater infrastructure and neighbouring properties. Table 6 presents a risk assessment of the identified design, operational, management & administrative risks particularly associated with this proposed OSMS.

Table 6. Risk assessment for the proposed OSMS.

Risk	Factors that increase likelihood	Risk reduction measures
Poor installation quality	- Lack of technical detail in Section 68 application - Over compaction of base in land application area - Poor quality materials - Inadequate inspections by Council - Design consultant not available or consulted during installation	- DA to be conditioned to require technical detail in Section 68 application. Technical detail is to include hydraulic design (including pump performance, friction loss through system), Stormwater, drainage cells and carpark slab design to be signed off by a civil engineer - All materials to be approved under Australian standards where appropriate or otherwise to be from a reputable manufacturer - Council inspections to occur during construction phase - OSMS designer contact details to be provided to installers
Hydraulic overload	- Misuse of amenities by tenants - Number of staff on-site in excess of 30 per day - Use of amenities by customers/tourists - Water saving fixtures not installed	- Tenant leases to outline that no trade waste is to enter OSMS and that customers/tourists are not to use amenities - Tenants are to be educated as to where trade waste amenities are and what their obligations are for not allowing trade waste into the OSMS - Tenants to provide property manager with staffing numbers so property managers can ensure only 30 staff are present per day - Council to not issue occupancy certificate until 4-star WELS rated toilets & 6-star WELS rated taps are installed - 24 hr contact number for plumber, service agent & pump truck company to be provided to property manager - Water meter to be installed on OSMS to monitor hydraulic flows. Water meter records to be submitted to Council quarterly
Biological failure from power outage causing cessation of pumps & aerators	- Poor quality wiring	- wiring to be completed by a licensed electrician and certificates provided to Council
Clogging of land application area from solids passing through treatment system	- Trade waste being put into system - Poor maintenance of filters and blackwater/greywater treatment systems	- 3000L septic tank installed prior to black & greywater treatment systems to provide buffering if trade waste enters system - filters to be installed at septic tank outlet and on delivery line from balancing tank to land application area - Cleaning of filters to occur every 3 months service interval

Risk	- Factors that increase likelihood	Risk reduction measures
Ingress of stormwater into land application area	- Poorly designed drainage around land application area - Poorly installed water proofing around land application area & stormwater bioretention basin - Poor quality products used in drainage	- Design of drainage & water proofing around land application area to be signed off by engineer - Installation of drainage and water proofing to be inspected by Council during construction - High level alarm in land application area drainage cells
Proximity to groundwater bore	- Wastewater with inadequate treatment allowing pathogens to enter groundwater and be drawn up by bore - Reduced buffer to bore	- Pathogen modelling undertaken in Section 2.6.3 demonstrating the reduced buffer to bore is acceptable - Wastewater treatment will include disinfection by chlorination
Wastewater application deep in soil profile	- Point of disposal in soil with heavier clay - Wastewater closer to groundwater	- permeability testing undertaken at depth of wastewater disposal - test holes excavated below point of disposal to check for bedrock/water table - Even distribution of wastewater across land application area by pressurised dripper lines
Small Lot size	- Inadequate are for standard land application area design	- land application area based on nutrient loading which in this case is larger than area required for hydraulic loading, reducing risk of hydraulic failure - Hydraulic loading when including toilet reuse will be 585 L/day instead of the design load of 900 L/day - 100% reserve area provided & included in land application area construction
Biological failure of treatment system from chemical/trade waste poisoning	- Inadequate training of tenants or inappropriate tenant behaviour - inadequate treatment capacity to buffer effect	- 3000L septic tank installed prior to black & greywater treatment systems to provide buffering if trade waste enters system - 10000L balance tank to provide emergency storage to allow trade waste to be blocked from entering land application area and instead be pumped out - As part of tenant's induction to units the trade waste facilities are to be explained to tenant - 24 hr contact number for plumber, service agent & pump truck company to be provided to property manager
Compression/damage to carpark/land application area from heavy vehicles	- Inadequate design of drainage cells & concrete slab - Vehicle heavier than specified entering land application area - Poor quality construction of drainage cells & concrete slab	- Drainage cell & concrete slab design to be signed off by civil engineer - Drainage cells with bearing strength of 210 tonnes/m^2 chosen for land application area - Signage placed at carpark entry stipulating maximum vehicle weight to enter carpark - Council to inspection drainage cell & concrete slab construction
Harsh odours from OSMS	- Trade waste entering OSMS - Hydraulic overload - Wastewater with high strength BOD	-Contact number for plumber & wastewater consultant to be provided to property manager - Water meter to installed on OSMS to monitor hydraulic flow and flows reported to Council quarterly - Property manager to audit tenants use of amenities
Difficulty accessing land application area under concrete slab for potential future repairs	- Poor design of land application area not providing inspection openings/access points	- Conservative land application design to reduce the need for future repairs & limit the chance of hydraulic overload - Suitable inspection openings & access points to be incorporated in technical design of land application area
Inadequate servicing	- Infrequent servicing - Servicing staff not trained adequately to service the installed OSMS - Servicing compliance not enforced by Council	- Service contract to be entered into - Service provider to demonstrate adequate level of training - compliance of 3 monthly servicing intervals to be enforced by Council

8. Section 68 Requirements

Following the approval of the Development Application relating to this OSMS design, detailed Section 68 applications will be required to be submitted for the OSMS and trade waste systems. It is recommended that Council condition the DA consent with the following information to be included in the OSMS Section 68 applications:

- Specific details on the chosen greywater & blackwater treatment systems,
- An integrated wastewater land application area/car park designed by a suitably qualified engineer,
- An up to date hydraulic design is to be resubmitted with engineers design including pump and pipe sizings,
- A plan of management suitable for issue to the property manager to outline maintenance requirements and system failure procedures.

9. Conclusion

A conceptual On-site Sewage Management System has been designed for a proposed light industrial unit development at Lot 10 DP 790360, Federal Drive, Federal. It is determined that suitable on-site wastewater management can be achieved at the subject site provided the following is undertaken:

- Separate blackwater (toilet flushing) and greywater (hand basin & kitchenette) sources to flow into separate treatment systems;
- Treat greywater to an advanced secondary standard including disinfection and plumb to toilets for flushing (dual connection of toilets to rainwater is also required);
- Treat blackwater to a secondary standard for disposal in the land application area;
- Install a 10000L balancing tank after the greywater/blackwater treatment systems to control wastewater dosing to the land application area;
- Construct a **544m²** land application area using drainage cells installed beneath a sealed carpark area;
- Incorporate the **water saving amenities** described within this report;
- Provide a Section 68 application following approval of the DA with the details nominated in Section 7 of this report to be included, being an engineered car park/land application area design, hydraulic design and a management plan.

10. References

Bureau of Meteorology (2019). Cape Byron Lighthouse Summary statistics. Retrieved from: http://www.bom.gov.au/climate/averages/tables/cw_058009.shtml, on the 25/07/2019. Australian Government.

Byron Shire Council (2004). *Design Guidelines for On-site Sewage Management for Single Households.* Protecting the Environment and Health of Byron Shire. Technical Guidelines for System Designers.

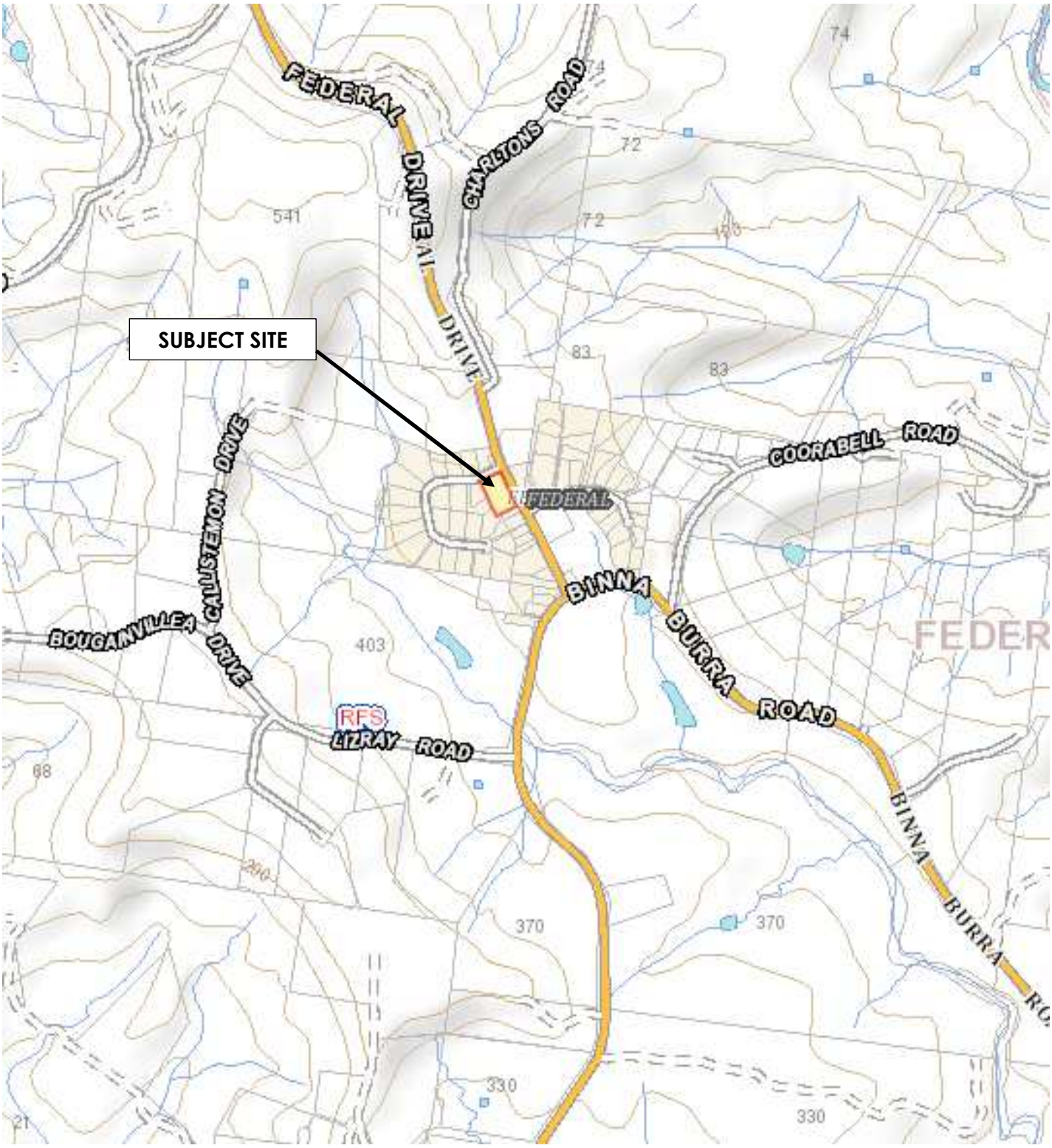
Cromer W C, Gardner E A & Beavers P D. (2001) An Improved Viral Die-Off Method for Estimating Setback Distances. *Proceedings of On-site '01 Conference: Advancing On-site Wastewater Systems*. Armidale: Lanfax Laboratories.

Davis, M L, Cornwell, D A (1998). *Introduction to Environmental Engineering*. McGraw Hill.

Department of Local Government, Environment Protection Authority, Department of Health, Department of Land & Water Conservation & the Department of Urban Affairs & Planning (1998). *Environment & Health Protection Guidelines On-site Sewage Management for Single Households*.

Fenton, G. (2003). *Planning on Liming*. Second Ed. Leaflet No. 4. NSW Agricultural Institute, Wagga Wagga, NSW.

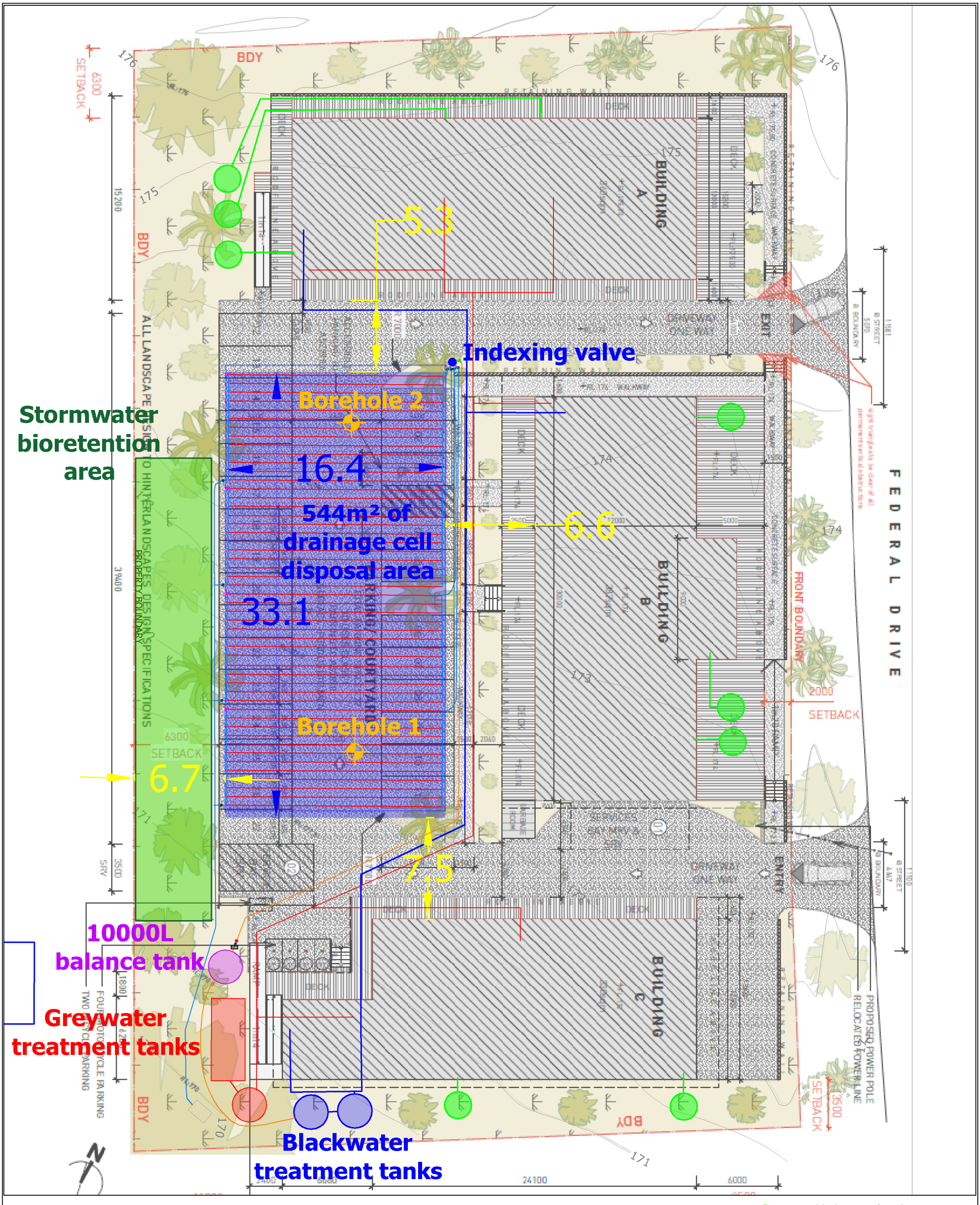
Morand, D. (1994). *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* Report. Soil Conservation Service of NSW, Sydney.



Source: NSW LPI Six Viewer (2015)
Date 9/12/2021
Project No. 19313_ww Revision E.docx
Scale: NTS

GREG ALDERSON AND ASSOCIATES
ABN 58 594 160 789
43 Main Street, Clunes, NSW 2480
Phone: (02) 6629 1552
Email: office@aldersonassociates.com.au

Exhibit No. 1.
SITE LOCATION
Lot 10 DP 790360, Federal Drive, Federal



Possible layout of trade waste tanks

Pressurised irrigation lines throughout disposal area

Notes:
1. Dimensions, tank locations and pipe layout are shown indicatively only.
2. Valve arrangements, final location of tanks and technical irrigation design to be provided within Section 68 application.

C:\Users\office\Desktop\work from home\jobs\19313\Revision E\19313__ww Rev E.dwg Tab. Possible layout

GREG ALDERSON & ASSOCIATES
ABN 58 594 160 789
43 Main Street, Clunes NSW 2480
Ph: 02 6629 1552 Fax: 02 6629 1566
E: office@aldersonassociates.com.au
Web: aldersonassociates.com.au

Client: Davgav Pty Ltd

Site address: Lot 10 DP 790360 Federal Drive, Federal

POSSIBLE OSMS LAYOUT

Drawn: DB

Source: Concept Plan OP11 from Amitran.

EXHIBIT NO: 2

Date: 9/12/21

Scale: 1:250

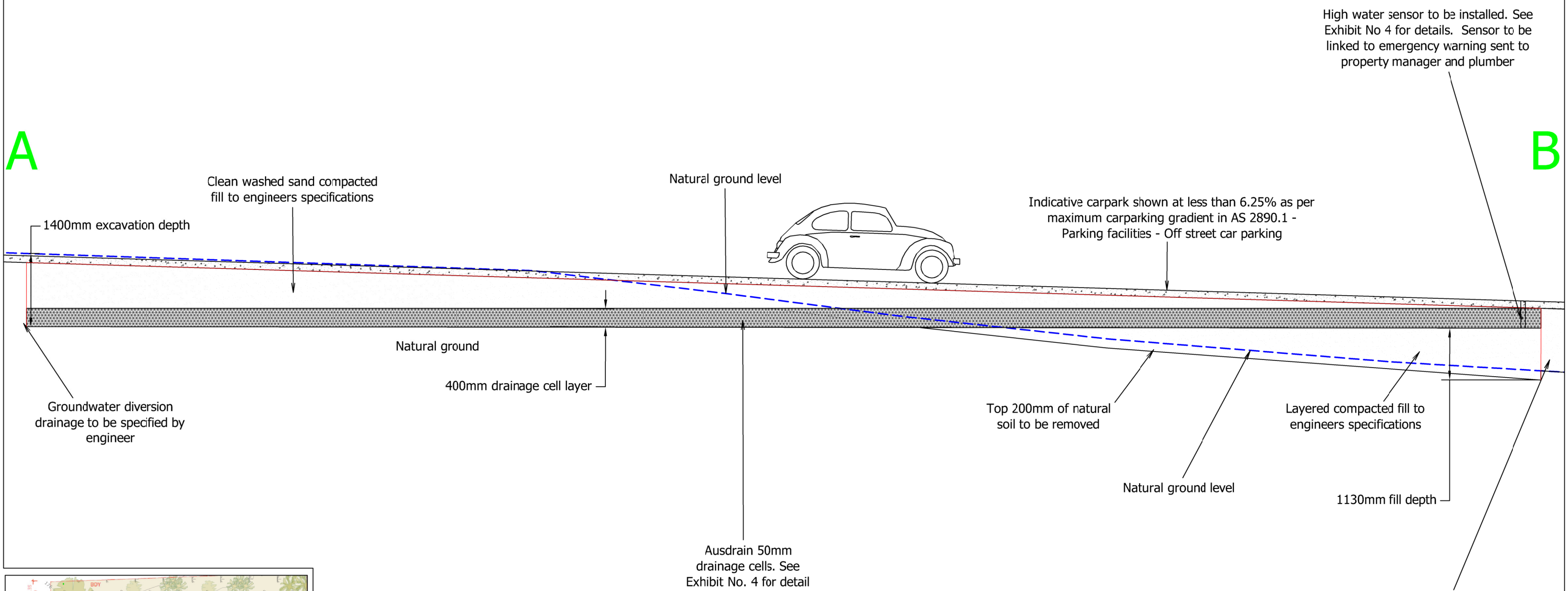
Project: Federal development - Fed Sheds

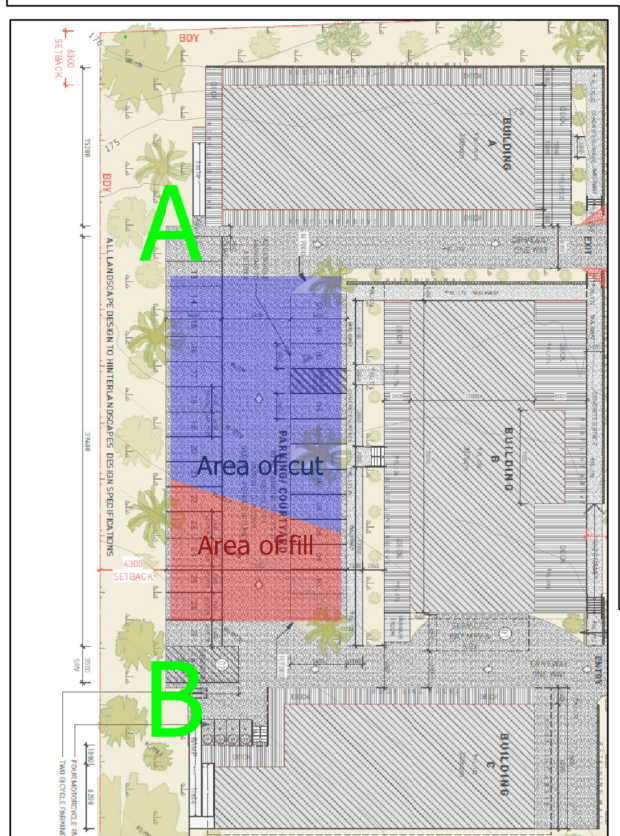
Revision: E

Job Number: 19313

Original Size: A3

FINAL CAR PARK/DRAINAGE CELL DESIGN TO BE COMPLETED BY SUITABLY QUALIFIED ENGINEER





Water proof lining sealing the disposal area from stormwater intrusion

C:\Users\offic\Desktop\work from home\jobs\19313\Revision E\19313_ww Rev E.dwg
Tab: cross section

GREG ALDERSON & ASSOCIATES
ABN 58 594 160 789
43 Main Street, Clunes NSW 2480
Ph: 02 6629 1552 Fax: 02 6629 1566
E: office@aldersonassociates.com.au
Web: aldersonassociates.com.au

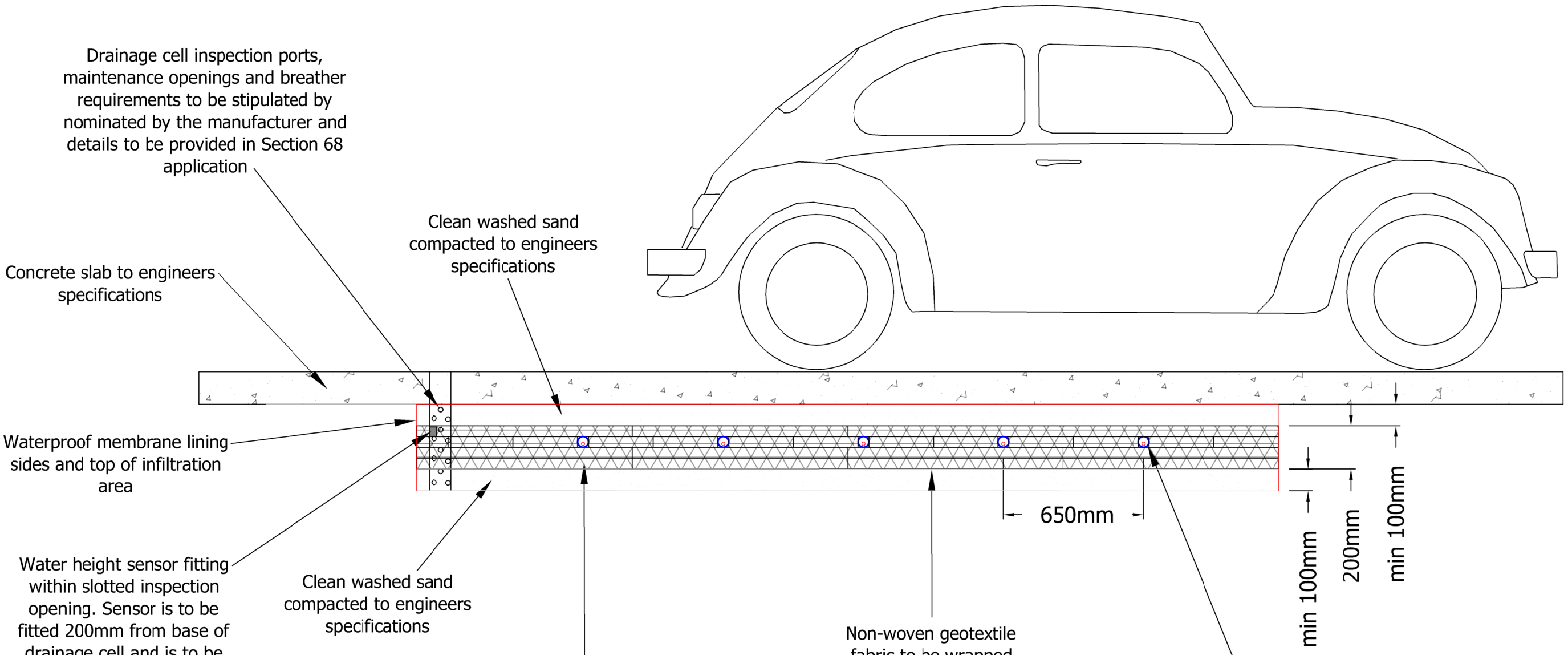
Client: Davgav Pty Ltd

Site address: Lot 10 DP 790360 Federal Drive, Federal

DISPOSAL AREA DETAIL

Drawn:	Source:	EXHIBIT NO: 3	Date:
DB	greg Alderson & Associates		9/12/21
Scale: 1:83		Project: Federal development - Fed Sheds	Revision: E
Job Number: 19313	Original Size: A3		

Notes:
1. Dimensions are shown indicatively and are based on general industry standards.
2. Exact dimensions and technical detail of backfill and cover requirements will be determined based on civel engineer design.
3. Venting and inspection openings for the drainage cells will be determined within the Section 68 application and will be based on drainage cell manufacturers recommendations.
4. High water sensors will be installed within drainage cell to notify property manager if pump out is required.



C:\Users\offic\Desktop\work from home\jobs\19313\Revision E\19313_ww Rev E.dwg
Tab: Cell detail

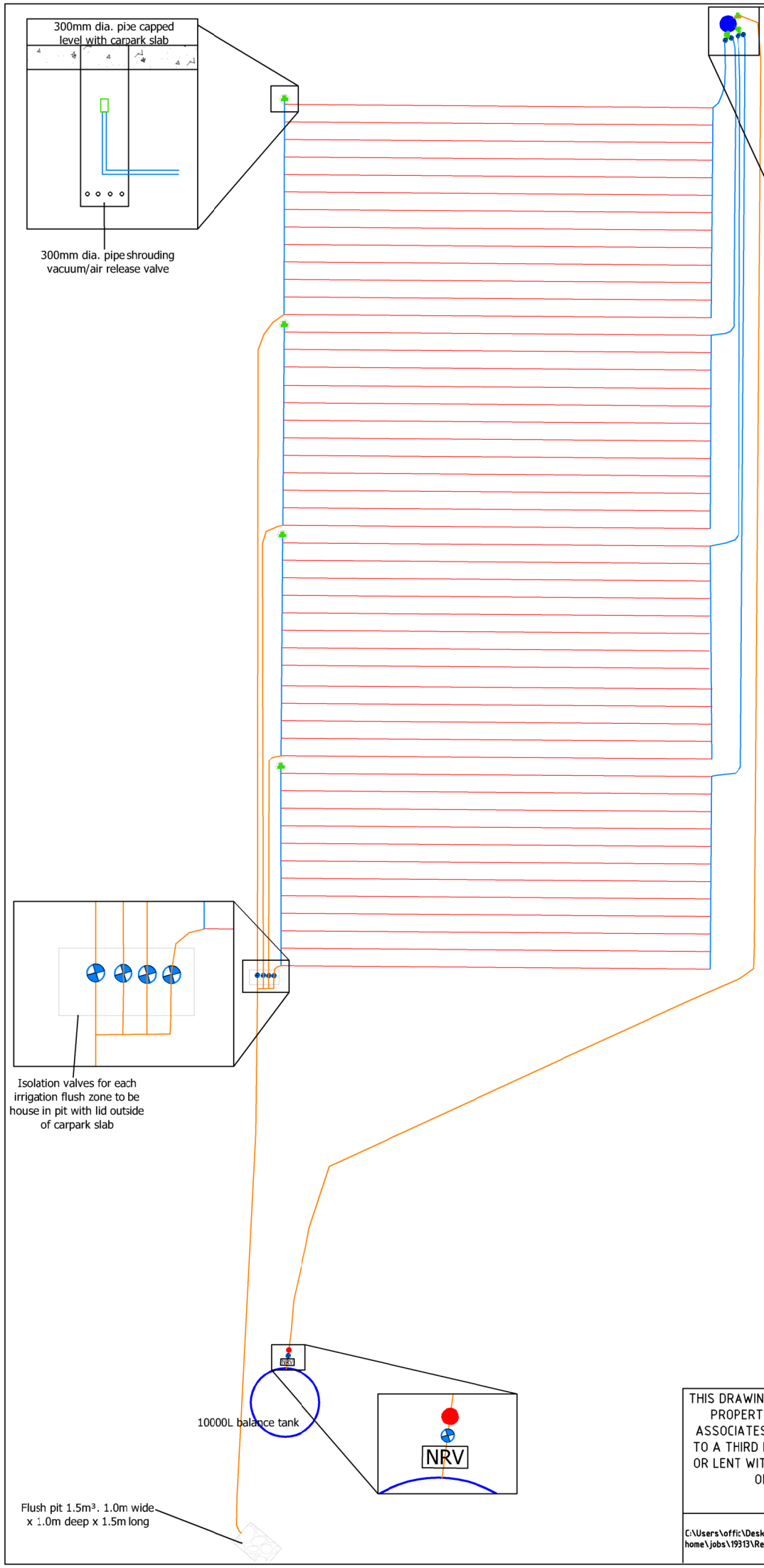
GREG ALDERSON & ASSOCIATES
ABN 58 594 160 789
43 Main Street, Clunes NSW 2480
Ph: 02 6629 1552 Fax: 02 6629 1566
E: office@aldersonassociates.com.au
Web: aldersonassociates.com.au

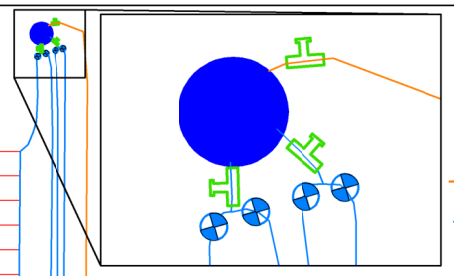
Client: Davgav Pty Ltd

Site address: Lot 10 DP 790360 Federal Drive, Federal

DISPOSAL AREA DETAIL

Drawn:	Source:	EXHIBIT NO: 4	Date:
DB	greg Alderson & Associates		9/12/21
Scale: 1:20		Project: Federal development - Fed Sheds	Revision: E
Job Number: 19313	Original Size: A3		





KEY

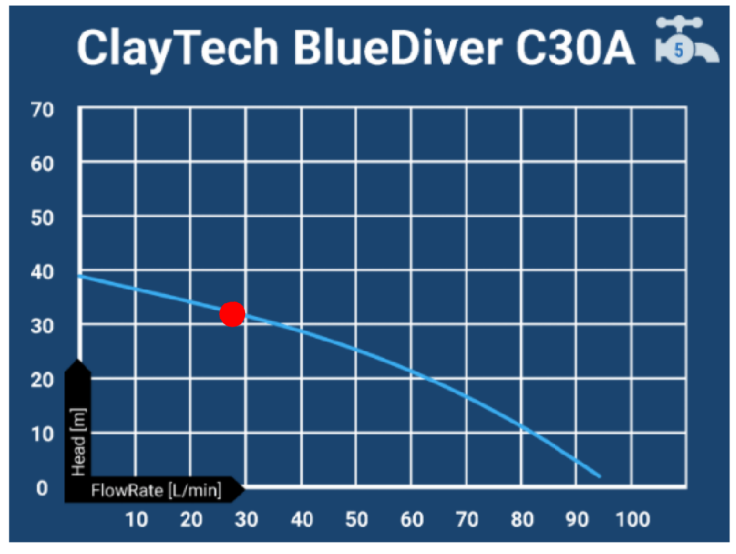
- Disc filter 140 micron 120 mesh
- Isolation valve (gate valve)
- 32mm PN12.5 Polyethylene main line
- 25mm PN12.5 polyethylene submain line
- Netafim Unibioline CNL subsurface pressurised irrigation line
- NRV — Non return valve
- Combination vacuum/air relief valve
- Krain indexing valve with 2 open ports

Irrigation Notes:

1. Pump in balance tank to operate on a timed system of 225L doses 4 times a day. Low water shut off switch also to be installed to prevent pump burn out.
2. Pump duty min. 29.8m head @ 27.7L/min required, a Claytech BlueDiver submersible pump is specified.
3. All dripper lines to be Netafim Unibiline CNL pressure compensating and separated by 0.65m with in-line 1.6L/hr emitters spaced at 0.4m.
4. Dripper line pipe to be sheathed in 50mm PVC & installed as part of drainage cells. See Exhibit No. 4.
5. Standby filter required for replacing duty filter when cleaning required.
6. Filter to be cleaned at 3 monthly intervals.
7. Manual cleaning of filter required in accordance with specifications.
8. Delivery pipe layout and AWTS location indicative & can be moved by plumber when site levels are taken. If balance tank location varies by more than 2m pump sizing will need to be recalculated.
9. A hydraulic design will still need to be submitted as part of the Section 68 application to confirm the design details following the engineer design of the drainage cells & car park.

Irrigation Checklist

Number of Equivalent People	30	
Irrigation area	540	m²
Number of irrigation blocks	2	
Number of doses per block	2	
Irrigation block	270	m²
Soil Type	Light clay	
Max site slope	0	% in land application area
Effluent quality	<30	BOD (mg/L)
	<45	TSS (mg/L)
Cover Crop	Absent	
Soil long term acceptance rate	5.00	mm/day
Holding tank volume	10	m³
Daily outflow from treatment system	0.9	m³/day
Irrigation system flow rate	27.69	L/minute
Irrigation system application rate	6.15	mm/hour
Gross Irrigation application	0.8	mm/irrigation area
Quantity of effluent/irrigation	1.7	m³/hour
Irrigation duration	0.14	hours
Irrigation frequency interval	6	hours
Pump Performance		
Total Dynamic Head (irrigation cycle)	29.8	m
Flow rate head (irrigation cycle)	27.7	l/min
Total Dynamic Head (flush cycle)	12.2	m
Flush velocity through lateral	0.5	m/s (irrigation block split for flushing)
Note run flush for	3	mins/zone
Componentry		
Automation controls	Float switches - modify to suit dose	
Filter	min. 120 mesh 50mm disc filter	
Gauges	2 requried either side of filter	
Alarm	alarm, connected to high water alarm	
Main	32mm PN12.5 PE 80	
Submains	25mm PN12.5 PE 80	
Laterals	Netafim unibioline pressure compensating CNL	
Flush Lines	25mm PN12.5 PE 80 (flush main 25mm)	
Control heads/solenoid valves	N/A	
Air release valves	on each block, high point	
Scour valves	on each block, low point	
Isolation valves	gate valve	
Absorption trenching	1.5m³ gravel bed (scour pit)	



Number of Blocks:	2	
Size of Block:	270.0	**m2**
Number of Doses/block	2	
Hydraulic Flow:	225	**L/dose/block**
Dripper Line Spacing:	0.65	**m**
Emitter Spacing:	0.4	**m**
Emitter Flow Rate:	1.6	**L/hr at 150kPa**
Total No. of Emitters Req'd:	1038	**/block**
Total Flow:	1662	**L/hour**
Daily Irrigation Time:	0.14	**hours/day**
	8.13	**minutes**
Pumping Rate Required:	1662	**L/hr**
(Flow rate)	27.69	**L/min**
	0.46	**L/sec**
System application rate:	6.15	**mm/hour**
Gross Irrigation Application:	0.8	**mm/irrigation area**
Length Lateral Per Block	415.3846154	**m**
Total Length Required	830.7692308	**m**

C:\Users\offic\Desktop\work from home\jobs\19313\Revision E\19313_ww Rev E.dwg Tab: Layout1

GREG ALDERSON & ASSOCIATES
ABN 58 594 160 789
43 Main Street, Clunes NSW 2480
Ph: 02 6629 1552 Fax: 02 6629 1566
E: office@aldersonassociates.com.au
Web: aldersonassociates.com.au

Client: Davgav Pty Ltd

Site address: Lot 10 DP 790360 Federal Drive, Federal

DISPOSAL AREA DETAIL

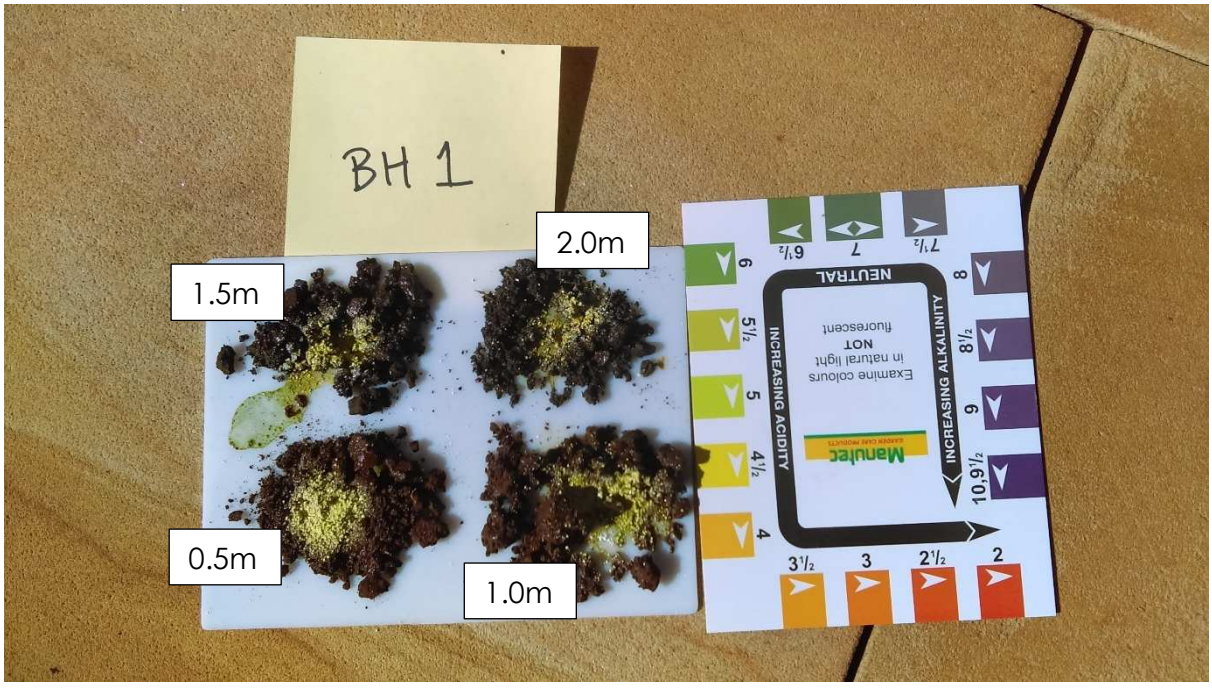
Drawn: DB | Source: greg Alderson & Associates | EXHIBIT NO: 5 | Date: 9/12/21

Scale: 1:200 | Job Number: 19313 | Original Size: A3

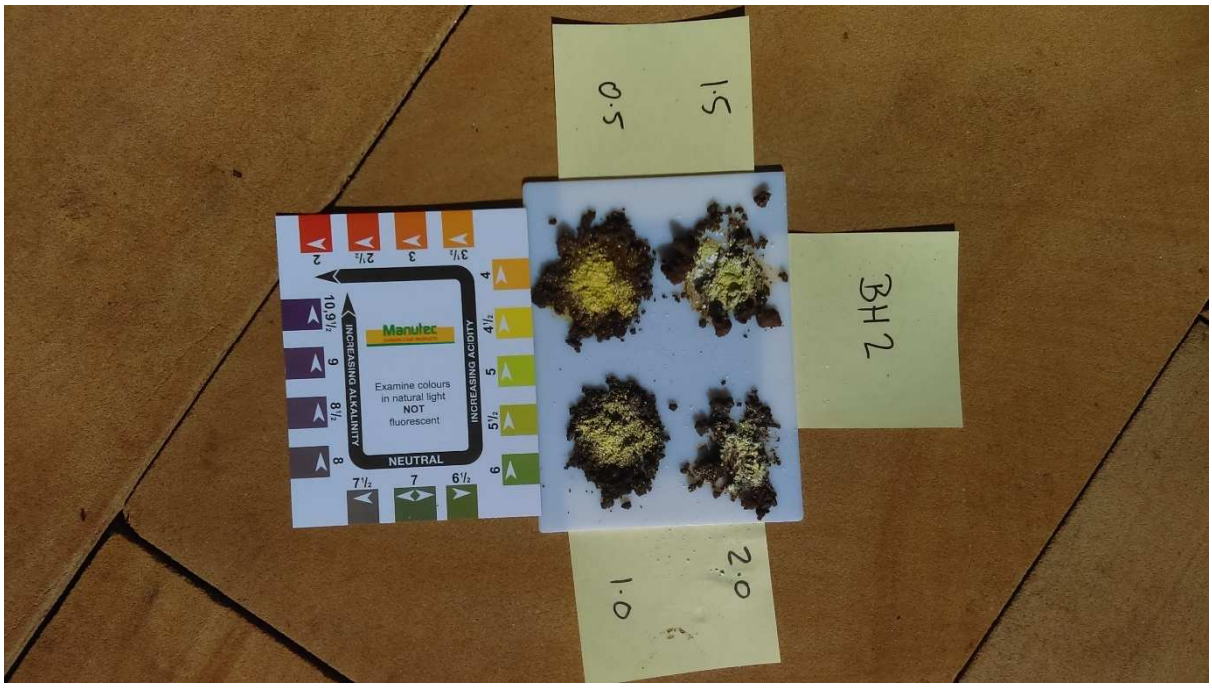
Project: Federal development - Fed Sheds | Revision: E

11. Appendix A — Photos of soil testing

Soil slacking after 24 hours in distilled water.



Soil pH testing in borehole 1.



Soil pH testing in borehole 2.

Soil bolus from 1.0m depth in bore hole 1.

Soil bolus from 1.5m depth in bore hole 1.

Soil bolus from 2.0m depth in bore hole 1.

Soil bolus from 1.0m depth in bore hole 2.

Soil bolus from 1.5m depth in bore hole 1.

Soil bolus from 2.0m depth in bore hole 2.

12. Appendix B — Geotechnical report

REPORT ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED COMMERCIAL DEVELOPMENT AT

LOT 10 FEDERAL DRIVE,

FEDERAL

PREPARED FOR

DAUGAN PTY LTD

PROJECT REF: GI 4574-A

7 MAY 2019

DRILLING ENVIRONMENTAL GEOTECHNICAL

P: 07 5523 3979
F: 07 5523 3981
E: admin@geotechinvestigations.com
www.geotechinvestigations.com

Geotech Investigations Pty Ltd ACN:154555478
OFFICE: Unit 3 / 42 Machinery Drive
Tweed Heads South NSW 2486
POSTAL: PO Box 6885
Tweed Heads South NSW 2486

TABLE OF CONTENTS

1. INTRODUCTION

This report details the results of a geotechnical investigation for the proposed commercial buildings at Federal Drive, Federal, described as Lot 10 on DP 790360. Geotech Investigations Pty Ltd (GI) was commissioned by Daugan Pty Ltd, the owner/s, to complete this investigation.

At the time of preparing this report, specific details for the proposed construction had not been supplied.

2. OBJECTIVES AND AGREED SCOPE OF SERVICE

The geotechnical investigation was to determine information regarding the subsurface conditions and how this influences the design of the new structure/s etc. The investigation and report involved:-

- Drilling and sampling of borehole(s) / Dynamic Cone Penetrometer test(s) at four locations within the general building area;
- Summarise the subsurface conditions, including any groundwater observations at the time;
- Typical constraints that these conditions may have on the project;
- General earthworks recommendations;
- Estimated movements relating from Shrink-Swell of cohesive soils;
- In-situ permeability testing at 2 locations at 1 m, 2 m and 3 m depth increments;
- Site Classification in accordance with AS2870-2011[1] to assist with footing and slab design; and
- Soil strength information and estimated settlements for footing and slab design.

3. SITE LOCATION AND DESCRIPTION

The site is 4,000 m^2 in area, rectangular shaped and located on the corner of Coachwood Court and Federal Drive, Federal. At the time of the investigation, the site was established with gardens, trees, lawns and an existing brick dwelling located at the northern portion of the allotment. The overall site grades from Coachwood Court positioned at approximately RL 104 m down towards the southern boundary which lies at about RL 99 m to RL 98 m.

[1] Australian Standard AS2870-2011 *'Residential footings and slabs - Construction'*, Standards Australia

Figure 1: Eastern boundary along Federal Road

Figure 2: View of northern corner of site at Borehole BH 1

Figure 3: Northern property boundary

Figure 4: Existing dwelling

4. GEOTECHNICAL CONDITIONS

4.1 Geotechnical Model

Reference to geological mapping by the Geological Survey of New South Wales 1:250,000 series 'Tweed Heads' sheet indicates the site is underlain by soils from the Tertiary aged Lismore Basalt of the Lamington Volcanics, which typically comprise *"basalt (agglomerate, bole)".*

4.2 Field Work Methodology

Fieldwork was undertaken on the 24th of April 2019, and comprised the drilling and sampling of four boreholes, designated BH 1 to BH 4, using a vehicle mounted drill rig. The boreholes were undertaken at accessible locations employing spiral flight auguring techniques to the termination depths of 3 m. Dynamic cone penetrometer test/s (DCPs) were carried out adjacent to the borehole/s to provide an estimate of the strength consistency or relative density of the subsurface soils. The approximate locations of the boreholes and DCP's (if any) are shown on Site Plan S01 attached in Appendix A.

This investigation has been carried out generally in accordance with AS 1726 – 2017[2] in terms of soil description. The fieldwork was carried out by an experienced geo-technician who positioned and logged the materials encountered in the boreholes and completed the DCP testing. At the completion of drilling, the boreholes were backfilled loosely with drill spoil.

4.3 Field Work Results

The results of the fieldwork are detailed on the Engineering Log attached in Appendix B, along with explanatory notes. Table 1 below provides a summary of these conditions.

Table 1: Summary of Subsurface Conditions *(depth below existing surface level)*

Material Descriptions	BH 1 (m)	BH 2 (m)	BH 3 (m)	BH 4 (m)
Fill "Uncontrolled"				
- Soft to Firm CLAY	NE	NE	NE	0 to 0.6
Residual (Natural)				
- Firm CLAY	0 to 0.2	0 to 0.2	0 to 0.2	NE
- Very stiff CLAY	0.2 to 3	0.2 to 3	0.2 to 3	0.6 to 3
Groundwater	NE	NE	NE	NE

Note: NE – Not Encountered

Documentation regarding the fill has not been provided, and considering the time since placement (likely greater than 20 years), it is not likely this information will be available, therefore the fill material is considered to be 'uncontrolled' in accordance with AS 2870.

It should be noted that groundwater is affected by various influences and will vary over time.

5. INTERPRETATION OF RESULTS

5.1 Earthworks

Specific details regarding earthworks for the proposed dwelling were not known at the time of preparing this report. However, earthworks are anticipated to comprise the clearing of the site, including demolition of the existing dwelling and removal of existing trees followed by minor levelling

[2] Australian Standard AS 1726-2017 *'Geotechnical site investigations'*, Standards Australia

to allow for a level building area/s followed by footing excavations. Should additional earthworks be proposed, this office must be contacted to provide further advice.

Generally, all earthworks are to be carried out in accordance with AS 3798 – 2007[3]. The following earthworks procedures can be used as a preliminary guide to support slab-on-ground and pavements:-

- The building and pavement areas, and areas to accept new fill, should be prepared by removing any existing "uncontrolled" fill (if any), loose debris, soils that are wet, or contain vegetation or deleterious materials. Where 'uncontrolled' fill (of any) cannot be feasibly removed prior to placement of new fill, GI must be notified to provide additional advice.
- The exposed subgrade should be test rolled using a 12 tonne roller (or similar), loaded water truck or dump truck to determine the presence of any soft spots, which should be excavated out and replaced with compacted select fill. The surface should be tyned to 0.2 m depth, moisture conditioned and then compacted. New fill material should be placed in layers not exceeding 200 mm to 300 mm loose thickness, or less depending on compaction equipment.
- Structural fill for earthworks should comprise select granular material, and be uniformly compacted to 95% Standard MDD (or higher), with moisture content within 2% wet or dry of OMC for cohesive material. Cohesionless material (sand material) is to be compacted to achieve a minimum 70% density index. Where backfill for service trenches is carried out, the above layer thickness applies however if vibrating plates are used, the layers are to be placed in 100mm loose thickness.
- Field testing must be carried out to confirm the standard of compaction achieved and the moisture content during the construction. The test frequency and extent of testing is to be carried out as per AS 3798, Section 8.0 and compaction testing is to be carried out by a NATA accredited laboratory.
- The placement of fill material to support building loads and pavements must be placed and compacted under 'Level 1' full-time geotechnical inspections and testing.

5.2 Shrink-Swell Movements and Site Classification

The conditions encountered must be classified as **'Class P'** in accordance with the provisions of AS 2870 due to the existing fill ground. This indicates that engineering principles must be adopted in the design for new footings and slabs.

Climatic conditions for this site are based on published data by Barnett[4], which indicate this region is marginally located within Climatic Zone 1 'Alpine/wet coastal'. A value for the change in soil suction

[3] Australian Standard AS 3798-2007 *'Guidelines on earthworks for residential and commercial developments'*, Standards Australia

[4] Barnett, I. C. and Kingsland, R.I., 1999: "*Assignment of AS2870 Soil Suction Change Profile Parameters to TMI Derived Climatic Zones for NSW"* Australian Geomechanics, Volume 34, No 3, September 1999, Australian Geomechanics Society, Barton ACT

at the surface (Δu) of 1.2 picofarads (pF) and a design depth soil suction change (H_S) value of 1.5 m could be adopted in calculations to determine y_S. AS 2870 indicates that seasonal cracking to a 'crack depth' of $H_S/2$ can be considered, but should be ignored for sites subject to recent (less than 5 years old) or proposed earthworks.

Based on previous laboratory testing on similar 'volcanic' soils in the nearby area, a shrink-swell Index (I_{SS}) of 3.5 to 4% / pF has been adopted in the y_S calculations. The results of these calculations reveal that under normal soil moisture variations (i.e. seasonal), y_S values for the existing shallow 'controlled' fill and natural clay profile encountered in the boreholes are estimated to be in the order of 40 mm to 45 mm. Therefore, a reactivity similar to 'Class H1' (highly reactive) in accordance with AS 2870 may be considered, provided settlements can be allowed for. Suggested design information is provided in Section 5.3 below.

This classification is relevant to sites subject to seasonal moisture changes only. Abnormal moisture conditions, such as from the removal or planting of trees (including on adjacent sites), poor site drainage, and development of gardens adjacent to the footings, may cause higher movements to occur, probably resulting in damage, which may or may not be within acceptable ranges.

5.3 Footings

Based on the results of the fieldwork, the exposed subgrade in the area of the proposed structures is likely to comprise areas of newly placed fill, isolated existing 'uncontrolled' clayey fill, over residual clays.

All footings, edge beams and internal beams of a slab-on-ground should be founded into the stiff (or better) residual clays, where an allowable bearing pressure of 100 kPa may be adopted, with bored piers / piles designed for an allowable end bearing pressure of 150 kPa.

Footing and construction loads **are not** to be supported in any topsoil, existing fill or proposed 'new' builders fill. The footing design may require the use of deepened footings, bored piers or excavation bucket piers to transfer loads into the appropriate founding stratum, with all loads founded in uniform material to limit the potential for differential settlements that are likely to damage the structure.

Inspection of footing trenches, bored piers or founding subgrade level should be carried out by GI for confirmation of the above bearing pressures prior to placement of concrete.

5.4 In-situ Permeability

As requested, testing to determine the permeability (K_{sat}) of the sub-surface material for the proposed buildings was carried out. Five (5) constant head field permeability tests were undertaken on the 24th of April 2019, and the results is presented in Table 2 below.

Table 2: Summary of Insitu Permeability Tests

Sample Location	Depth of Hole below Surface Level (m)	Section of Tested Zone (m)	Soil Description	Permeability K_{sat} (m/sec)
BH 1	1 m	0.75 – 1.15	Silty CLAY	*$6.5x10^{-7}$
BH 1	2 m	1.7 – 2.1	Silty CLAY	*$5.9x10^{-7}$
BH 1	3 m	2.51 – 2.86	Silty CLAY	$2.8x10^{-6}$
BH 3	1 m	0.7 – 1.05	Silty CLAY	*$6.5x10^{-7}$
BH 3	2 m	1.7 – 2.05	Silty CLAY	(1)

Notes: * The type of test method adopted, 'The Talsma-Hallam permeameter, with modifications' is not usually used or accurate for permeabilities greater than $1x10^{-7}$ m/s which is typically outside the land application of wastewater treatment systems.

(1) The test results did not represent the soil profile and other test results and for this purpose this result has not been recorded in Table 2.

This results for permeability testing indicate that the material is likely to be a 'Silty Clay' typically in the range of a 'Soil Category 5' in accordance with Table E1 AS 1547:2012 (On-site domestic wastewater management).

5.5 General Comments

The above information and calculations are based on existing site soils and assumes moisture conditions within site soils vary due to seasonal effects only. If abnormal moisture conditions occur (due to drying by tree root action, or wetting by leaking pipes, water ponding, etc.), significantly greater movements are considered possible, and the Site Classification should be reconsidered.

It is recommended that good engineering practices be adopted in the design of all structures and foundations and in particular, the following should be considered for movement in sensitive areas underlain with reactive materials:-

- Trees and shrubs should not be planted or be allowed to remain closer than their mature height to movement sensitive structures / features. Where trees exist within this distance, deeper foundations may be required and GI should be notified immediately to provide such recommendations;
- Soil moisture should be controlled to limit moisture content change during or following construction;
- The site should be graded to allow surface water to easily flow into a suitable stormwater system, and prevent ponding, particularly adjacent to the footings; and
- Underground services should be made flexible where possible.

During periods of high rainfall, concentrated surface water runoff or ponding may occur on the site. Suitable drainage and diversion of all runoff into the stormwater articulation systems to prevent water ponding is necessary prior, during and after the construction of any proposed residential development.

CSIRO Publication BTF 18 *'Foundation Maintenance and Footing Performance: A Homeowner's Guide'*, attached in Appendix D, provides some guidance material and should be provided to land owners.

6. LIMITS OF INVESTIGATION

This report is written for a structure within the scope of AS 2870, which does not provide standardised designs for: -

- Two-storey construction with a suspended concrete floor at the first level.
- Construction of three storeys or more, including basement levels.

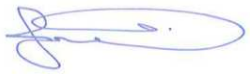
Recommendations given in this report are based on the information supplied regarding the proposed building construction in conjunction with the findings of the investigation. Any change in the construction type or building location may require additional testing and/or make recommendations invalid.

Every reasonable effort has been made to locate the test sites so that the borehole/s are representative of the soil conditions within the area to be investigated. The client should be made aware, however, that this assessment has been based on limited site data using small diameter borehole/s, and that subsurface conditions may vary across the area.

If you should require any further information or clarification, please do not hesitate to contact this office.

Yours faithfully
For and on behalf of
Geotech Investigations Pty Ltd

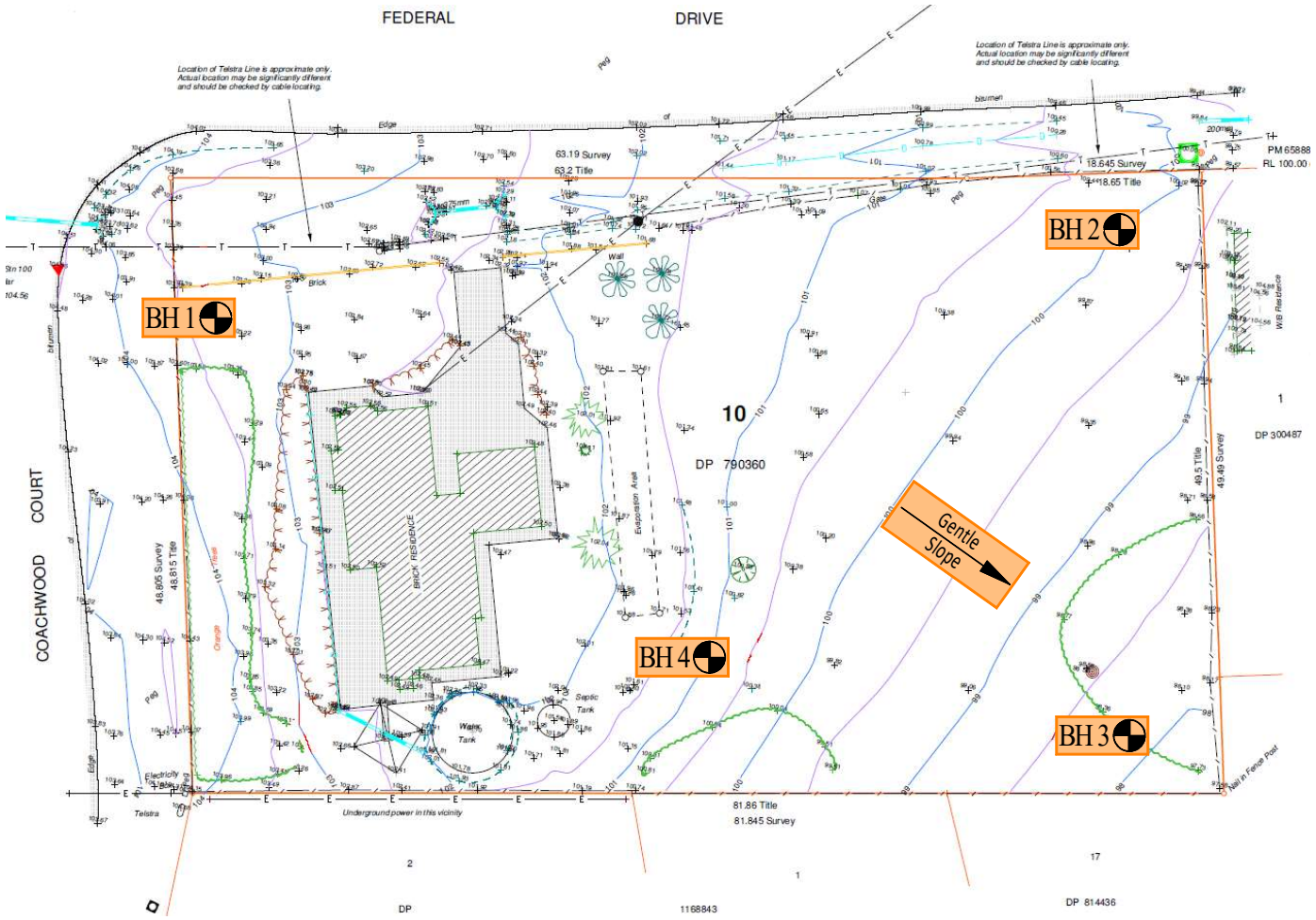
Andrew O'Carroll *BEng (Civil),*
Geotechnical Engineer



James Walle *RPEQ (15701), RPEng (Civil), BEng (Civil)*
Senior Geotechnical Engineer

APPENDIX A

SITE PLAN S01



LOCALITY IMAGE

Locality Image courtesy of
Google Earth & NSW Globe

NORTH

SITE PLAN

GeoTech INVESTIGATIONS PTY LTD
Unit 3 / 42 Machinery Drive
PO Box 6885
Tweed Heads South NSW 2486
PH: 0755 233 979
FAX: 0755 233 981
EMAIL: admin@geotechinvestigations.com
WEB: www.geotechinvestigations.com

CLIENT: DAUGAN PTY LTD

PROJECT: PROPOSED COMMERCIAL BUILDING AT LOT 10 FEDERAL DRIVE, FEDERAL

DRAWING REF: S01: SITE PLAN

LEGEND:
Borehole and Dynamic Cone Penetrometer Location

Site Plan provided by
Ken Chelsworth Registered Surveyor
Ref. No.: 1156 Dated: 11/10/16 & 07/12/16

APPROXIMATE NORTH

NORTH

DATE: 24.04.2019

OUR REF / JOB No.: GI 4574-a sp

DRAWN BY: DJB

Drawing not to scale.
Printed dimensions only.

APPENDIX B

ENGINEERING LOG – BOREHOLE PROFILES BH 1 TO BH 4
GEOTECHNICAL REPORT STANDARD NOTES

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	N:		E:	

CLIENT: DAUGAN PTY LTD	**BOREHOLE I.D. :** BH 1
PROJECT: LOT 10 FEDERAL DRIVE, FEDERAL	**JOB No.:** GI 4574-a
EQUIPMENT TYPE: GT-10 **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD		0.5		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Dark red/brown	F		1 1	RESIDUAL
		1.0			VSt		2 4 4 6 8 8 8 10	
		1.5		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Dark pink/brown				
		2.0						
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 1 TERMINATED AT 3 m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	**Date:**	24/04/19	**Checked By:**	AOC	**Date:**	7/5/19

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	N:		E:	

CLIENT: DAUGAN PTY LTD	**BOREHOLE I.D. :** BH 2
PROJECT: LOT 10 FEDERAL DRIVE, FEDERAL	**JOB No.:** GI 4574-a
EQUIPMENT TYPE: GT-10 **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD		0.5		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Dark red/brown	F		1 1 3 4 8 8 8 10 10	RESIDUAL
		1.0			VSt			
		1.5		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Orange/brown				
		2.0						
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 2 TERMINATED AT 3 m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	**Date:**	24/04/19	**Checked By:**	AOC	**Date:**	7/5/19

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	N:		E:	

CLIENT: DAUGAN PTY LTD	**BOREHOLE I.D. :** BH 3
PROJECT: LOT 10 FEDERAL DRIVE, FEDERAL	**JOB No.:** GI 4574-a
EQUIPMENT TYPE: GT-10 **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD		0.5 1.0		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Dark red/brown	F VSt		1 2 3 3 5 8 8 8 10	RESIDUAL
		1.5 2.0 2.5 3.0		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Grey				
		3.5 4.0 4.5						

BH 3 TERMINATED AT 3 m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	**Date:**	24/04/19	**Checked By:**	AOC	**Date:**	7/5/19

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	N:		E:	

CLIENT: DAUGAN PTY LTD	**BOREHOLE I.D. :** BH 4
PROJECT: LOT 10 FEDERAL DRIVE, FEDERAL	**JOB No.:** GI 4574-a
EQUIPMENT TYPE: GT-10 **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD		0.5		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w<w_p$), Dark brown with grey mottling	F		1 1 1 1 1 4	FILL
		1.0		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Dark red/brown	VSt		4 4 4 8 8 8 10	RESIDUAL
		1.5		(CH) Sandy CLAY: High plasticity, Fine sand, With silt, Dry to moist ($w>w_p$), Orange/brown				
		2.0						
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 4 TERMINATED AT 3 m – LIMIT OF INVESTIGATION

METHOD		WEATHERING	
AD	Auger Drilling	EW	Extremely
C	Casing	HW	Highly
MS	Mud Support	DW	Distinctly
NMLC	Rock Coring	MW	Moderately
RR	Rock Roller	SW	Slightly
TC	Tri Cone	F	Fresh
WB	Wash Bore		

WATER	
▼	Water Level
►	Water Seepage

CONSISTENCY / DENSITY / ROCK STRENGTH			
VS	Very Soft	D	Dense
S	Soft	VD	Very Dense
F	Firm	Fb	Friable
St	Stiff	ELw	Extremely Low
VSt	Very Stiff	VLw	Very Low
Hd	Hard	Lw	Low
VL	Very Loose	M	Medium
L	Loose	H	High
MD	Medium Dense	VH	Very High

SAMPLES / TESTS	
U( )	Undisturbed (size in mm)
D	Disturbed
BS	Bulk Sample
DCP	Dynamic Cone Penetrometer
SPT	Standard Penetrometer Test
N	Number of blows for SPT / 300mm
VS	Vane Shear
A	Acid Sulfate Sample
PP	Pocket Penetrometer (kPa)

Logged By:	DAW	Date:	24/04/19	Checked By:	AOC	Date:	7/5/19

SCOPE These standard notes may be of assistance when understanding terms and recommendations given in this report. These notes are for general conditions and not all terms given may be of concern to the report attached. The descriptive terms adopted by Geotech Investigations Pty Ltd are given below and are largely consistent with Australian Standards AS1726-1993 'Geotechnical Site Investigations'.

CLIENT can be described and is limited to the financier of this geotechnical investigation.

LEGALITY and privacy of this document is based on communication between Geotech Investigations Pty Ltd and the client. Unless indicated otherwise the report was prepared specifically for the client involved and for the purposes indicated by the client. Use by any other party for any purpose, or by the client for a different purpose, will result in recommendations becoming invalid and Geotech Investigations Pty Ltd will hold no responsibility for problems which may arise.

GEOTECHNICAL REPORTS are predominantly derived using professional estimates determined from the results of fieldwork, in-situ and laboratory testing and experience from previous investigations in the area, from which geotechnical engineers then formulate an opinion about overall subsurface conditions. The client must be made aware that the investigations are undertaken to ensure minimal site impact using test-pits or small diameter boreholes and soil conditions on-site may vary from those encountered during the investigation.

CLIENTS RESPONSIBILITY to notify this office should there be adjustments in proposed structure/location or inconsistencies with material descriptions given in this report and those encountered on site. Geotech Investigations Pty Ltd is able to provide a range of services from on-site inspections to full project supervision to confirm recommendations given in the report.

CSIRO Publication BTF 18 'Foundation Maintenance and Footing Performance: A Homeowner's Guide' explains how to adequately maintain drainage during and post construction which lies as the responsibility of the client. Suitable drainage ensures recommendations given in this report remain valid.

INVESTIGATION METHODS adopted by Geotech Investigations Pty Ltd are designed to incorporate individual project-specific factors to obtain information on the physical properties of soil and rock around a site to design earthworks and foundations for proposed structures. The following methods of investigation currently adopted by this company are summarised below:-

HAND AUGER – investigations enable field work to be undertaken where access is limited. The materials must have sufficient cohesion to stand unsupported in an unlined borehole and there must be no large cobbles boulders or other obstructions which would prevent rotation of the auger.

TEST-PITS – investigations are carried out with an excavator or backhoe, allowing a visual inspection of sub-surface material in-situ and from samples removed. The limit of investigation is restricted by the reach of the excavator or backhoe.

CONTINUOUS SPIRAL FLIGHT AUGERING TECHNIQUES – investigations are advanced by pushing a 100mm diameter spiral into the sub-surface and withdrawing it at regular intervals to allow sampling or testing as it emerges.

WASH BORING – investigations are advanced by removing the loosened soil from the borehole by a stream of water or drilling mud issuing from the lower end of the wash pipe which is worked up and down or rotated by hand in the borehole. The water or mud carries the soil up the borehole where it overflows at ground level where the soil in suspension is allowed to settle in a pond or tank and the fluid is re-circulated or discharged to waste as required.

NON-CORE ROTARY DRILLING – investigations are advanced using a rotary bit with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from feel and rate of penetration.

ROTARY MUD DRILLING – is carried out as above using mud as support and circulating fluid for the borehole drilling. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling.

CONTINUOUS CORE DRILLING – investigations are carried out in rock material, specimens of rock in the form of cylindrical cores are recovered from the drill holes by the means of core barrel. The core barrel is provided at its lower end with a detachable core bit which carries industrial diamond chips in a matrix of metal. Rotation of the barrel by means of the drill rods causes the core bit to cut an annulus in the rock, the cuttings being washed to the surface by a stream of pumped down the hollow drill rods.

TESTING METHODS adopted by Geotech Investigations Pty Ltd to determine soil properties include but not limited to the following:-

U50 – Undisturbed samples are obtained by inserting a 50mm diameter thin-walled steel tube into the material and withdrawing with a sample of the soil in a moderately undisturbed condition.

PP – Pocket Penetrometer tests are commonly used on thin walled tube samples of cohesive soils to evaluate consistency and approximate unconfined compressive strength of saturated cohesive soils. They may also be used for the same purpose in freshly excavated trenches.

VS – Vane Shear test are commonly used in-situ or on thin walled tube samples of cohesive soils by introducing the vane into the material where the measurement of the undrained shear strength is required. Then the vane is rotated and the torsional force required to cause shearing is calculated.

DCP – Dynamic Cone Penetrometer tests are commonly used in-situ to measure the strength attributes of penetrability and compaction of sub-surface materials.

SPT – Standard Penetration Tests are commonly uses to determine the density of granular deposits but are occasionally used in cohesive material as a means of determining strength and also of obtaining a relatively undisturbed sample. Samples and results are obtained by driving a 50mm diameter split tube through blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. Blow counts are recorded for 150mm intervals with the sum of the number of blows required for the second and third 150mm of penetration is termed the "standard penetration resistance" or the "N-value".

GEOLOGICAL ORIGINS of sub-surface material plays a considerable role in the development of engineering parameters and have been summarised as follows:-

FILL – materials are man made deposits, which may be significantly more variable between test locations than naturally occurring soils.

RESIDUAL – soils are present in a region as a result of weathering over the geological time scale.

COLLUVIAL – soils have been deposited recently, on the geological time scale, as soils being transported slowly down slope due to gravitational creep.

ALLUVIAL – soils have been deposited recently, on the geological time scale, as water borne materials.

AEOLIAN – soils have been deposited recently, on the geological time scale, as wind borne materials.

SOIL DESCRIPTION is based on an assessment of disturbed samples, as recovered from boreholes and excavations, and from undisturbed materials. Soil descriptions adopted by Geotech Investigations Pty Ltd are largely consistent with AS 1726-1993 '*Geotechnical Site Investigation'.* Soil types are described according to the predominating particle size, qualified by the grading of other particles present on the following bases detailed in Table 1.

COHESIVE SOILS ability to hold moisture known as its liquid limit is the state of a soil when it goes from a solid state to a liquid state described in Table 2

TABLE 1

Soil Classification	Particle Size
Clay	< 0.002 mm
Silt	0.002 – 0.06 mm
Sand	0.06 – 2.00 mm
Gravel	2.00 – 60.0 mm

TABLE 2

Descriptive Type	Range of Liquid Limit %
Of low plasticity	≤ 35
Of medium plasticity	> 35 ≤ 50
Of high plasticity	> 50

Furthermore to soil description cohesive soils are described on their strength (assessed in conjunction with penetration tests) and liquid limit. Non-cohesive soil strengths are described by their density index. With descriptions for cohesive and non-cohesive soils summarised in Table 3.

TABLE 3

COHESIVE SOILS		NON-COHESIVE SOILS	
Term	**Undrained Shear Strength kPa**	**Term**	**Density Index %**
Very soft	≤ 12	Very Loose	≤15
Soft	> 12 ≤25	Loose	> 15 ≤35
Firm	> 25 ≤50	Medium Dense	> 35 ≤65
Stiff	> 50 ≤100	Dense	> 65 ≤85
Very Stiff	> 100 ≤200	Very Dense	> 85
Hard	> 200		

Description of terms used to describe material portion are summarised in Table 4.

TABLE 4

COARSE GRAINIED SOILS		FINE GRAINED SOILS	
% Fines	**Modifier**	**% Coarse**	**Modifier**
≤ 5	Omit or 'trace'	≤ 15	Omit or 'trace'
> 5 ≤12	Describe as 'with'	> 15 ≤30	Describe as 'with'
> 12	Prefix soil as 'silty/clayey'	> 30	Prefix soil as 'sandy/gravelly'

ROCK DESCRIPTIONS are determined from disturbed samples or specimens collected during field investigations. A rocks presence of defects and the effects of weathering are likely to have a great influence on engineering behaviour.

Rock Material Weathering Classification is summarised in Table 5.

TABLE 5

Term	Symbol	Definition
Residual Soils	-	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to decomposition of weathering products in pores
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fresh rock	FR	Rock shows no signs of decomposition or staining

Rock Material Strength Classification is summarised in Table 6.

TABLE 6

Term	Symbol	Point load index (MPa) I_s50	Field guide to strength
Extremely Low	EL	≤0.03	Easily remoulded by hand to a material with soil properties
Very Low	VL	>0.03 ≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3cm thick can be broken by finger pressure
Low	L	>0.1 ≤0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling
Medium	M	>0.3 ≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty
High	H	>1.0 ≤3.0	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer
Very High	VH	>3.0 ≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer
Extremely High	EH	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer

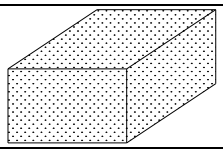
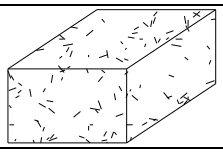
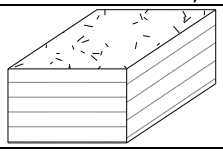
Rock Material Defect Shapes are summarised in Table 7.

TABLE 7

Term	Description
Planar	The defect does not vary in orientation.
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps.
Irregular	The defect has many sharp changes of orientation
Smooth	The defect has a flat even finish
Rough	The defect has a irregular disoriented finish

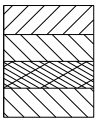
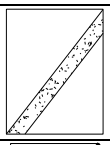
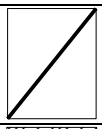
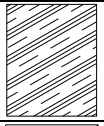
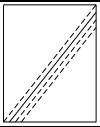
Rock Material Texture and Fabric are summarised in Table 8.

TABLE 8

Geological Description	Massive		Layered (Bedded foliate cleaved)
Diagram			
Fabric Type	Effectively homogenous and isotropic. Bulky or equi-dimensional grains uniformly distributed	Effectively homogeneous and isotropic. Elongated	Effective homogeneous with planar anisotropy. Elongated or tabular grains or pores in a layered arrangement

Rock Material Defect Type is summarised in Table 9

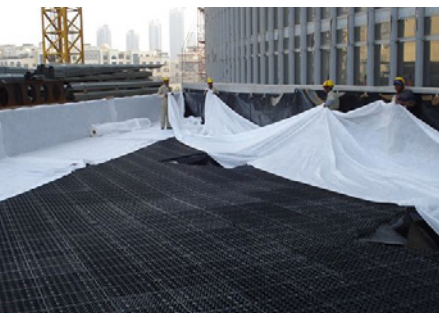
TABLE 9

Term	Definition	Diagram
Bedding	Signifying existence of beds or laminate. Planes dividing sedimentary rocks of the same or different lithology. Structure occurring in granite and similar rocks evident in a tendency to split more or less horizontally to the land surface	
Cross Bedding	Also called cross-lamination or false bedding. The structure commonly present in granular sedimentary rocks, which consists of tabular, irregularly lenticular or wedge-shaped bodies lying essentially parallel to the general stratification and which them selves show pronounced lamination structure in which the laminae are steeply inclined to the general bedding.	
Crushed Seam	A fracture at a more or less acute angle to applied force generally with some pulverized material along its surface	
Joint	A fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.	
Parting	A small joint in rock or a layered rock where the tendency of crystals to separate along certain planes that are not true cleavage planes.	
Sheared Zone	A fracture that results from stresses which tend to shear one part of a specimen past the adjacent part	

13. Appendix C — Ausdrain Drainage Cell Information

DRAINAGE CELL
MODULAR HORIZONTAL DRAINAGE

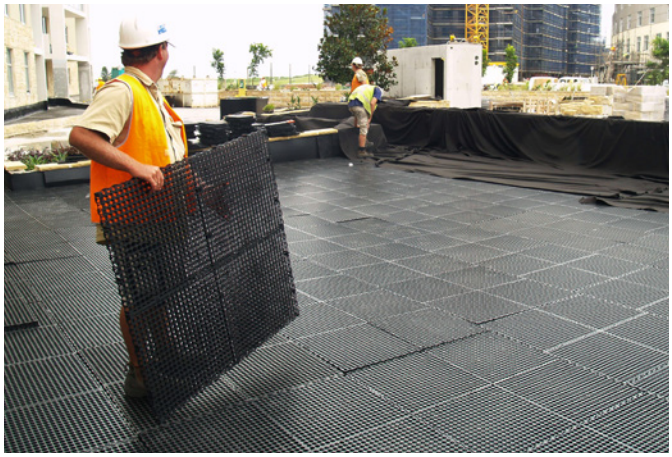
Roof gardens
Planter boxes
Podium landscaping
Sports fields
Civil works



ausdrain
STORMWATER SOLUTIONS

30MM & 50MM DRAINAGE CELL

AUSDRAIN 30mm and 50mm drainage cells provide a permanent, structural and non-clogging void between the building structure and the soil profile that will not collapse or distort. The void enables a direct flow of water to designated outlets resulting in superior drainage efficiency compared to conventional gravel filled systems.



APPLICATIONS	FEATURES	BENEFITS
• Planter boxes • Roof gardens • Podiums • Retaining walls • Civil works • Sports fields • Under slab drainage	• High compressive strength • Open structure • Durable • Lightweight • Supplied in large panels • Superior quality • Made from recycled plastic	• Trafficable • High flow rate • Long life expectancy • Easy to handle • Quick to install • Chemical and bacteria resistant • Environmentally friendly

AUSDRAIN 30mm and 50mm drainage cells are the most effective and efficient drainage solutions for planter boxes, roof gardens, podium landscaped areas and most horizontal drainage applications.

It features high compressive strength and is lightweight reducing weight on the underlying structure by 98% compared to gravel. In addition, there is a 5:1 reduction in the drainage medium height enabling greater scope for soil depth and plantings.

The drainage cell in combination with a geotextile fabric acts as the protection layer for the underlying waterproof membrane and provides ventilation for concrete slabs.

The geotextile fabric is placed over the drainage cell and combined with a layer of washed river sand, filters the water eliminating staining caused by gravel, stone and soil.

AUSDRAIN 30mm and 50mm drainage cells are supplied in easy to handle panels making installation fast, saving valuable time and labour on large scale projects. The panels can also be easily interlocked for vertical installation within planter boxes and against retaining walls.

Technical data

30mm drainage cell

Height	30mm
Width	500/1000mm
Length	500/1000mm
Weight	3kg/sqm
Surface void	>65%
Compressive strength	>80 t/m²
Flow rate	>14400 litres/h/sqm @ 1% fall
Service temperature	-30c +120c
Material	Recycled polypropylene
Chemical properties	Unaffected by moulds and algae, soil-bourne chemicals and bacteria

50mm drainage cell

Height	50mm
Width	300/1000mm
Length	500/1200mm
Weight	6.5kg/sqm
Surface void	>90%
Compressive strength	>210 t/m²
Flow rate	>19200 litres/h/sqm @ 1% fall
Service temperature	-30c+120c
Material	Recycled polypropylene
Chemical properties	Unaffected by moulds and algae, soil-bourne chemicals and bacteria

Installation procedure

1. Place the drainage cell over the surface of the membrane and butt together (interlocking is not required). For additional protection a layer of 3mm protection board is recommended under the drainage cell.

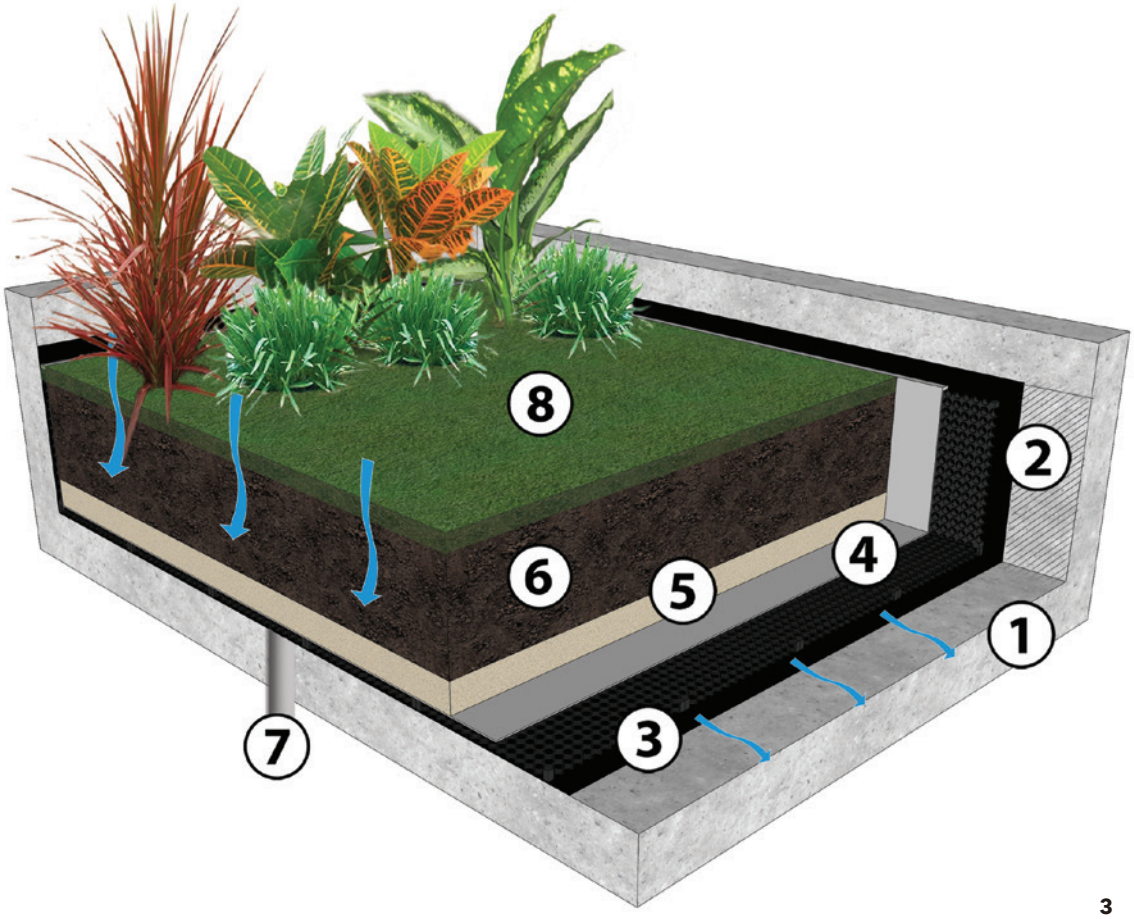
2. Cut the drainage cell where required using a hand or circular saw.

3. Place the filter fabric over the drainage cell allowing for a 150mm overlap at each seam. Allow for additional fabric to cushion the edges of the drainage cell around the perimeter against the waterproof membrane and walls.

4. Install the drainage cell vertically to the walls of the planter boxes if required and cover with filter fabric. Allow sufficient overlap to the horizontal sections.

5. Lay a 50-100mm layer of coarse washed river sand to act as a filtration layer over the fabric.

6. Lay the soil profile to the required depth. Please note that a minimum of 300mm of cover is required before allowing vehicles and machinery to traffic over the surface.



1. Waterproof membrane
2. Protection board
3. Drainage cell
4. Geotextile fabric
5. Coarse washed river sand
6. Soil mix
7. Outlet pipe
8. Planting/landscaping

Distributed by:

Manufactured from 100% environmentally friendly recycled plastics

For more in-depth information about AUSDRAIN™ and the products the company provides contact:

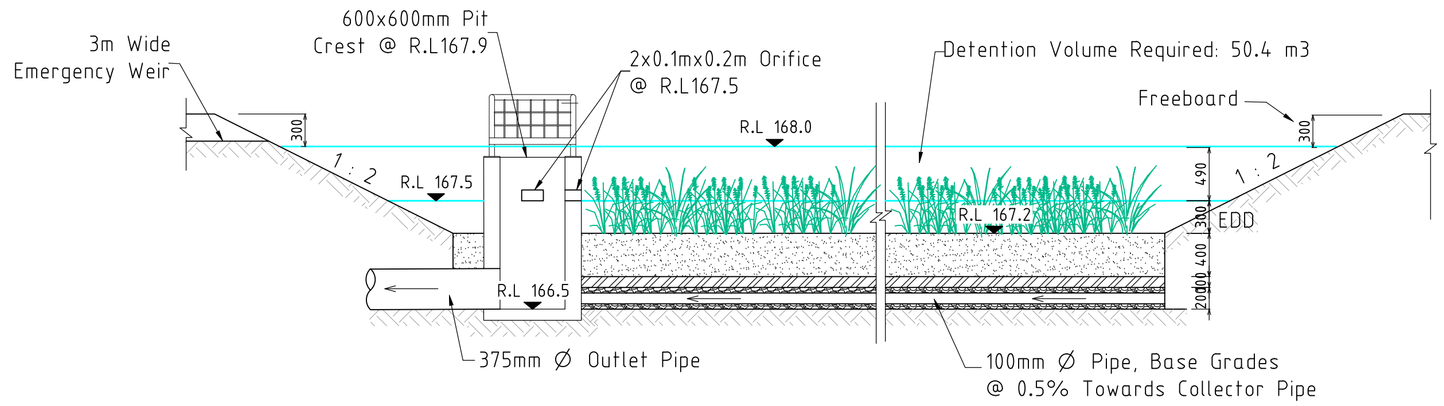
T 61 2 9929 7650
F 61 2 9929 7655
E enquiries@ausdrain.com

PO Box 164
Cammeray NSW 2062
Australia

1300 AUSDRAIN (1300 287 372)
(Toll free within Australia)

or visit
www.ausdrain.com

14. Appendix D – Stormwater concept plan



BIORETENTION/DETENTION BASIN SECTION

0 0.4 0.8 1.2 1.6 2.0m
Scale 1:40 - A1 (1:80 - A3)

LEGEND:

- CATCHMENT BOUNDARY
- SW — PIPE DRAINAGE
- SW — EXISTING PIPE
- EXISTING EASEMENT
- BIORETENTION SYSTEM
- ON-SITE DETENTION
- 12 x 3kL RAINWATER TANK

Bioretention/Detention Basin:

Filter Area:	36 m^2
EDD Volume:	17 m^3
Detention Volume Required:	50.4 m^3
Freeboard Volume:	51 m^3
Total Volume:	118.4 m^3

0 3 6 9 12 15m
Scale 1:300 - A1 (1:600 - A3)

AEP (%)	Flow (m3/s)	Pipe Diameter Required
1% AEP	0.19	375mm Ø
2%AEP	0.17	300mm Ø
5% AEP	0.15	300mm Ø with 285mm Ø Orifice Plate
10% AEP	0.13	300mm Ø with 270mm Ø Orifice Plate
20% AEP	0.11	300mm Ø with 250mm Ø Orifice Plate

	Flow (m3/s)
Capacity of 150mm Ø existing pipe	0.03
20% AEP	0.11
Capacity of 225mm Ø	0.08

DEVEL. APPLIC. No. :		DATE : 20.08.19	
PROJECT LEADER : DMcK	DESIGNER : DMcK		
DRAFTSPERSON : TP	CHECKED : DMcK		
APPROVED FOR AND ON BEHALF OF FLOODWORKS.			
SCALE : AS SHOWN	DATUM : AHD	FULL SIZE : A1	
PROJECT No.: FW00002	DRAWING No. : SK-03	VERSION: B	

FLOODWORKS
Email: derek.mackenzie@floodworks.com.au
PO Box 823
Lismore NSW 2480
T: 0474 793 362
www.floodworks.com.au

PROJECT:
AMITRAN-DEVELOPMENT
AT LOT 10/DP790630
FEDERAL DRIVE, FEDERAL

CLIENT:
AMITRAN

DRAWING TITLE :
OPERATIONAL CONTROL PLAN

VER.	DESCRIPTION	APPR.	DATE
B	FOR DISCUSSION	DMcK	20.08.19
A	PRELIMINARY ISSUE FOR REVIEW	DMcK	08.08.19

15. Appendix E — Groundwater Works Summary for bore

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 23, 2012

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW070327

Works Details (top)

GROUNDWATER NUMBER	GW070327
LIC-NUM	30BL151095
AUTHORISED-PURPOSES	DOMESTIC
INTENDED-PURPOSES	DOMESTIC
WORK-TYPE	Well
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1992-12-07
FINAL-DEPTH (metres)	4.00
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	30 - NORTH COAST
RIVER-BASIN	203 - RICHMOND RIVER
AREA-DISTRICT	
CMA-MAP	9540-1S
GRID-ZONE	56/2
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	R.L. at Surface
NORTHING	6830505.00
EASTING	544460.00
LATITUDE	28 39' 7"

LONGITUDE	153 27' 18"
GS-MAP	
AMG-ZONE	56
COORD-SOURCE	GD.,ACC.GIS
REMARK	

Form-A (top)

COUNTY	ROUS
PARISH	JASPER
PORTION-LOT-DP	L16 DP814436

Licensed (top)

COUNTY	ROUS
PARISH	JASPER
PORTION-LOT-DP	16 814436

Water Bearing Zones (top)

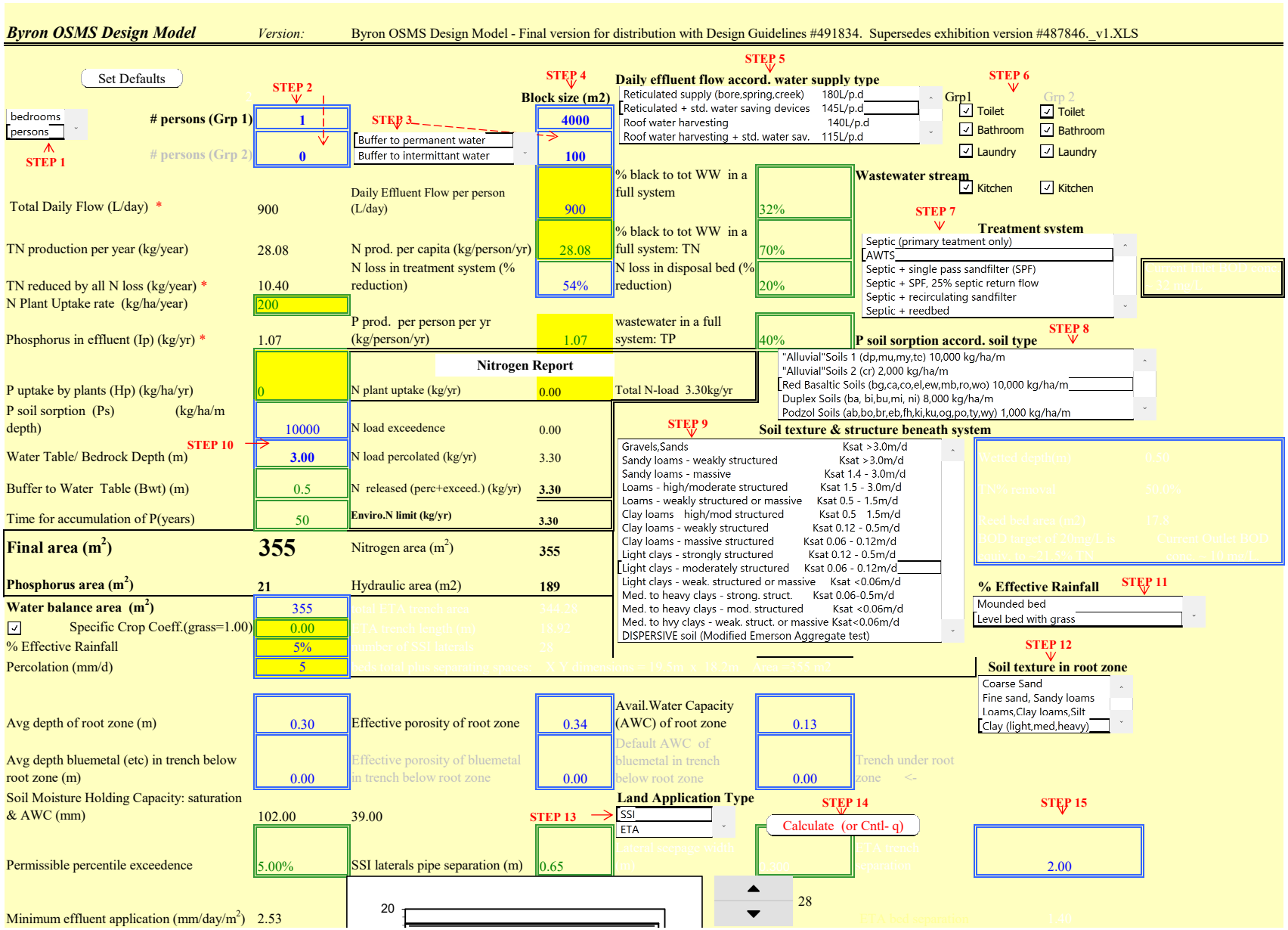
no details

Drillers Log (top)

no details

---

16. Appendix F — Council Design Model Printout


Byron OSMS Design Model
Version:
Byron OSMS Design Model - Final version for distribution with Design Guidelines #491834. Supersedes exhibition version #487846._v1.XLS
Set Defaults
STEP 1
bedrooms
persons
STEP 2
persons (Grp 1)
1
persons (Grp 2)
0
STEP 3
Buffer to permanent water
Buffer to intermittant water
STEP 4
Block size (m2)
4000
100
STEP 5
Daily effluent flow accord. water supply type
Reticulated supply (bore,spring,creek) 180L/p.d
Reticulated + std. water saving devices 145L/p.d
Roof water harvesting 140L/p.d
Roof water harvesting + std. water sav. 115L/p.d
STEP 6
Grp1
Grp 2
Toilet
Bathroom
Laundry
Kitchen
Wastewater stream
Total Daily Flow (L/day) *
900
Daily Effluent Flow per person (L/day)
900
% black to tot WW in a full system
32%
TN production per year (kg/year)
28.08
N prod. per capita (kg/person/yr)
28.08
% black to tot WW in a full system: TN
70%
TN reduced by all N loss (kg/year) *
10.40
N loss in treatment system (% reduction)
54%
N loss in disposal bed (% reduction)
20%
STEP 7
Treatment system
Septic (primary teatment only)
AWTS
Septic + single pass sandfilter (SPF)
Septic + SPF, 25% septic return flow
Septic + recirculating sandfilter
Septic + reedbed
N Plant Uptake rate (kg/ha/year)
200
Phosphorus in effluent (Ip) (kg/yr) *
1.07
P prod. per person per yr (kg/person/yr)
1.07
wastewater in a full system: TP
40%
STEP 8
P soil sorption accord. soil type
"Alluvial"Soils 1 (dp,mu,my,tc) 10,000 kg/ha/m
"Alluvial"Soils 2 (cr) 2,000 kg/ha/m
Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
Duplex Soils (ba, bi,bu,mi, ni) 8,000 kg/ha/m
Podzol Soils (ab,bo,br,eb,fh,ki,ku,og,po,ty,wy) 1,000 kg/ha/m
Nitrogen Report
P uptake by plants (Hp) (kg/ha/yr)
0
N plant uptake (kg/yr)
0.00
Total N-load 3.30kg/yr
P soil sorption (Ps) (kg/ha/m depth)
10000
N load exceedence
0.00
STEP 9
Soil texture & structure beneath system
Gravels,Sands Ksat >3.0m/d
Sandy loams - weakly structured Ksat >3.0m/d
Sandy loams - massive Ksat 1.4 - 3.0m/d
Loams - high/moderate structured Ksat 1.5 - 3.0m/d
Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
Clay loams high/mod structured Ksat 0.5 1.5m/d
Clay loams - weakly structured Ksat 0.12 - 0.5m/d
Clay loams - massive structured Ksat 0.06 - 0.12m/d
Light clays - strongly structured Ksat 0.12 - 0.5m/d
Light clays - moderately structured Ksat 0.06 - 0.12m/d
Light clays - weak. structured or massive Ksat <0.06m/d
Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
Med. to heavy clays - mod. structured Ksat <0.06m/d
Med. to hvy clays - weak. struct. or massive Ksat<0.06m/d
DISPERSIVE soil (Modified Emerson Aggregate test)
STEP 10
Water Table/ Bedrock Depth (m)
3.00
N load percolated (kg/yr)
3.30
Buffer to Water Table (Bwt) (m)
0.5
N released (perc+exceed.) (kg/yr)
3.30
Time for accumulation of P(years)
50
Enviro.N limit (kg/yr)
3.30
Final area (m2)
355
Nitrogen area (m2)
355
Phosphorus area (m2)
21
Hydraulic area (m2)
189
Water balance area (m2)
355
Specific Crop Coeff.(grass=1.00)
0.00
% Effective Rainfall
5%
Percolation (mm/d)
5
STEP 11
% Effective Rainfall
Mounded bed
Level bed with grass
STEP 12
Soil texture in root zone
Coarse Sand
Fine sand, Sandy loams
Loams,Clay loams,Silt
Clay (light,med,heavy)
Avg depth of root zone (m)
0.30
Effective porosity of root zone
0.34
Avail.Water Capacity (AWC) of root zone
0.13
Avg depth bluemetal (etc) in trench below root zone (m)
0.00
Effective porosity of bluemetal in trench below root zone
0.00
Default AWC of bluemetal in trench below root zone
0.00
Trench under root zone <-
Soil Moisture Holding Capacity: saturation & AWC (mm)
102.00
39.00
Land Application Type
SSI
ETA
STEP 13
STEP 14
Calculate (or Cntl- q)
STEP 15
Permissible percentile exceedence
5.00%
SSI laterals pipe separation (m)
0.65
lateral seepage width (m)
ETA trench separation
2.00
Minimum effluent application (mm/day/m2)
2.53
20
28

17. Appendix G – Example of an Advanced secondary treatment system to treat greywater

Certificate of Accreditation

Sewage Management Facility
Aerated Wastewater Treatment System
Advanced Secondary Effluent

This Certificate of Accreditation is issued by the Secretary of the NSW Ministry of Health pursuant to Clause 41(1) of the Local Government (General) Regulation 2005.

System: ***Taylex Concrete ABS 1500 Advanced STS AWTS***

Manufacturer: ***Taylex Industries Pty Ltd***

Address: ***56 Prairie Road, Ormeau, QLD, 4208***

The Taylex Concrete ABS 1500 Advanced STS AWTS as described in Schedule A, has been Accredited as a sewage management facility in accordance with the Secondary Treatment System Accreditation Guideline 2018 for use in single domestic premises in NSW. This Accreditation is subject to the conditions and permitted uses specified in Schedule B.

A/Director, Environmental Health
for Secretary (delegation PH335)

Issued: *9 October 2019*
Certificate No: *STS-AWTS049*
Expires: *31 December 2025*

Schedule A: Specification / Description of the Taylex Concrete ABS1500 Advanced STS-AWTS

Name and Model of STS: Taylex Concrete Advanced Blower System (ABS) 1500 Advanced STS-AWTS

The Taylex Concrete ABS 1500 Advanced STS-AWTS is designed to treat sewage from a residential dwelling occupied by a maximum of 10 persons.

The Taylex Concrete ABS 1500 Advanced STS-AWTS is contained in the following vessel(s):

- Vessel 1: A collecton well with design capacity of 9300 L. NSW Health Accreditation Number STCW045; alternatively,
- A collection well 10700L -T3, or 11,000L T4 or 11,700 T6 with operational capacity of 5,880 L. NSW Health Accreditation Number STCW045.

Chamber	Design capacities
Primary treatment	2526 L (1684L + 842L)
• Partition	yes
Secondary treatment	842 L
• Aeration chamber	2071 L
• Clarifier	602 L
• Irrigation chamber	621L
Emergency storage	1000+ L
Operational water level (depth)	(mm)
• primary	1430
• secondary	1410

The emergency storage capacity is achieved by allowing primary, secondary and aeration chambers to rise without shortcuts.

The Taylex Concrete ABS1500 Advanced STS-AWTS is contained in one concrete collection well having the attached specification sheet "Concrete ABS150".

Schedule B: Conditions of Accreditation

1. General

1.1 Prior to installation the owner/occupier of the premises shall make an application, in accordance with Clause 26 of the *Local Government (General) Regulation 2005,* to the local council for approval to install and operate the Taylex Concrete ABS 1500 Advanced STS-AWTS as a Sewage Management Facility in accordance with Section 68, Part C of the *Local Government Act 1993.*

1.2 The local council shall apply those Conditions of Accreditation, appropriate to the owner / occupier, to any approval to operate the Taylex Concrete ABS 1500 Advanced STS-AWTS issued under Clause 45(4), *Local Government (General) Regulation 2005.*

1.3 In accordance with Clause 36 of the *Local Government (General) Regulation 2005,* the Taylex Concrete ABS 1500 Advanced STS-AWTS shall have an expected service life of 5 years in the case of mechanical and electrical components and 15 years in the case of other components.

1.4 The owner / occupier shall ensure that the Taylex Concrete ABS 1500 Advanced STS-AWTS is installed or constructed:

- in accordance with the accredited specifications of the type tested unit and in accordance with good trade practice, and
- so as to allow ease of access for maintenance, and
- with regard to the health and safety of users, operators and persons maintaining the facility, and
- must be installed or constructed so as to make appropriate provision for access to and removal of contents in a safe and sanitary manner, and
- must, if it is intended to be a permanent fixture, be anchored to prevent movement.

1.5 The manufacturer / supplier shall ensure that the Taylex Concrete ABS 1500 Advanced STS-AWTS is supplied, constructed and installed in accordance with the design (including the disinfection unit) as submitted and accredited by the NSW Ministry of Health. The Taylex Concrete ABS 1500 Advanced STS-AWTS shall not be modified or altered except that alternate individual mechanical and electrical components such as pumps, PLCs, etc, may be substituted provided that the component meets the Accredited design specification.

1.6 Any permanent modification or variations to the Accredited design of the Taylex Concrete ABS 1500 Advanced STS-AWTS shall be submitted for separate consideration and variation of the Certificate of Accreditation by the NSW Ministry of Health. Modifications will be considered in accordance with section 2.3.13 of AS1546.3:2017.

1.7 Each Taylex Concrete ABS 1500 Advanced STS-AWTS shall be permanently and legibly marked by the manufacturer in accordance with section 3 of AS1546.3:2017.

1.8 The manufacturer shall supply with each Taylex Concrete ABS 1500 Advanced STS-AWTS an owner's manual, which sets out the care, operation, maintenance and on-going management requirements of the system. The owner's manual prepared by the manufacturer shall specifically contain a plan for the on-going management of the. The plan shall include details of:

- the treatment process,
- procedures to be followed in the event of a system failure,
- emergency contact numbers,
- maintenance requirements,
- inspection and sampling procedures to be followed as part of any on-going monitoring program developed by the local authority.

1.9 The manufacturer shall provide the following information to each local council where it is intended to install an AWTS in their area once Ministry Accreditation has been obtained:

- Statement of warranty
- Statement of service life
- Quality Assurance Certification
- Installation Manual
- Service Manual
- Owner's Manual
- Manufacturer's Service Report Form
- Engineering Drawings
- Specifications
- A4 Plans
- Certificate of Accreditation documentation from NSW Health.

The manufacturer need not provide the above information to the local council where the information or document is contained on the manufacturer's web site.

2. Installation and Commissioning

2.1 The owner / occupier shall have the Taylex Concrete ABS 1500 Advanced STS-AWTS inspected and checked by the manufacturer or the manufacturer's agent. The manufacturer or the agent is to certify that the system has been installed and commissioned in accordance with its design, conditions of Accreditation and any additional requirements of the local council.

2.2 The owner / occupier shall ensure that all electrical work is carried out on the Taylex Concrete ABS 1500 Advanced STS-AWTS by a licensed electrician and in accordance with the relevant provisions of AS/NZS 3000.

2.3 The owner / occupier shall not commission the Taylex Concrete ABS 1500 Advanced STS-AWTS unless the land application system has been completed.

3. Maintenance

3.1 The owner / occupier of the premises shall enter into a minimum 12-month contract or agreement with a service agent and ensure that the Taylex Concrete ABS 1500 Advanced STS-AWTS is serviced:

- in accordance with the manufacturer's / supplier's service manual and using the manufacturer's / supplier's service sheet; and
- by a service agent who

- has completed a course on the servicing and maintenance of STS; and has some supervised servicing experience or extensive un-supervised experience;
- is employed or authorised by the manufacturer / supplier of the Taylex Concrete ABS 1500 Advanced STS-AWTS;
- uses replacement parts which meet the minimum specification of the Taylex Concrete ABS 1500 Advanced STS-AWTS;
- has advised of their name, contact details and credentials to the local council;
- submits a completed NSW Health "Local Council Service Report" (attached) to the local council immediately after each and every service;
- shall report to the local council any instances where the owner / occupier refuses to authorise repairs, replacement of parts or maintenance; and
- does not perform electrical work or enter confined spaces unless trained and is suitably qualified to do so.

3.2 The owner/occupier shall not service the Taylex Concrete ABS 1500 Advanced STS-AWTS unless they are an authorised agent.

3.3 The Taylex Concrete ABS 1500 Advanced STS-AWTS once installed and commissioned shall be serviced at 3 monthly intervals.

3.4 The manufacturer / supplier of the Taylex Concrete ABS 1500 Advanced STS-AWTS shall place on its web site a copy of the service manual, service sheet or form and specifications for the Taylex Concrete ABS 1500 Advanced STS-AWTS to facilitate servicing, maintenance and repairs. Commercial-in-confidence documents may be provided directly to the service agent without uploading to the web site.

3.5 Each three monthly service shall, as a minimum where provided, include a check on all mechanical, electrical and functioning parts of the system including:

- The chlorinator and replenishment of the disinfectant,
- Any alternative disinfection unit,
- Replace a UV light globe at recommended intervals and keep a record,
- Pump and air blower,
- The alarm system,
- Slime growth on the filter media,
- Operation of the sludge return system,
- The effluent irrigation area,
- On-site testing for free residual chlorine, pH and dissolved oxygen at the appropriate check points.

4. Verification

4.1 Effluent from the Taylex Concrete ABS 1500 Advanced STS-AWTS taken in any random grab sample shall comply with the following standard:

- BOD^5 less than 30 mg/L
- TSS less than 45 mg/L
- E. coli less than 100 cfu/100 ml
- Free residual chlorine greater than 0.5 and less than 2.0 mg/L

5. Permitted uses

5.1 The effluent is suitable for re-use for garden purposes by way of any of the forms of irrigation as described in AS/NZS 1547:2012:

- above ground spray irrigation; and/or
- surface drip irrigation covered by mulch; and/or
- sub-surface drip irrigation installed at around 100 mm depth; and or
- any form of sub-soil application.

Each of the forms of irrigation or application is subject to the approval of the local authority.

6. Advanced Secondary Treatment System

The Taylex Concrete ABS 1500 Advanced STS-AWTS when tested by a Product Certification Body in accordance with AS1546.3:2017 was found to comply with the Advanced Secondary Effluent Criteria as follows:

TABLE 2.1 (Abrev) AS1546.3:2017
ADVANCED SECONDARY EFFLUENT COMPLIANCE CRITERIA FOR A STS

Parameter	Advanced secondary effluent	
	90% of Samples	**Maximum**
BOD5	≤ 10mg/L	20 mg/L
TSS	≤ 10 mg/L	20 mg/L
E. coli *	≤ 10 cfu/100mL	30 cfu/100mL
FAC þ	Minimum 0.5 mg/L†	N/A
Turbidity ?	N/A	10 NTU

* Where disinfection is required.
þ Where chlorine disinfection is used.
† Minimum level, not 90% of samples.
? Where UV light is used for disinfection .

NSW GOVERNMENT | Health

Local Council STS (DGTS) Service Report: February 2018		
Owner's Name:	Local Council:	
Installation Address:		
System Brand & Model:	☐ Domestic	☐ Commercial
Date of this service: / /	Date of last Service: / /	Next service due: / /

Has the STS/DGTS been **serviced** in accordance with the manufacturer's / supplier's requirements and using the service sheet? ☐ Yes ☐ No
If "No" why not?

STS/DGTS **functioning** correctly? ☐ Yes ☐ No
If "No" why not?

According to sludge-judge or other methodology is de-sludging needed? ☐ Yes ☐ No
If "Yes" what action is recommended?

Offensive odours? ☐ Yes ☐ No If "Yes" what action is recommended?

Alarms tested and functional? ☐ Yes ☐ No If not "functional" what action is recommended?

Final Effluent Quality

Tested?	☐ Yes	☐ No
Disinfected?	☐ Yes	☐ No
Chlorine tablets remaining?	☐ Yes	☐ No
Quality?	☐ Satisfactory	☐ Unsatisfactory

On what evidence is this judgement made? If "Unsatisfactory" what action was recommended?

Land Application Area

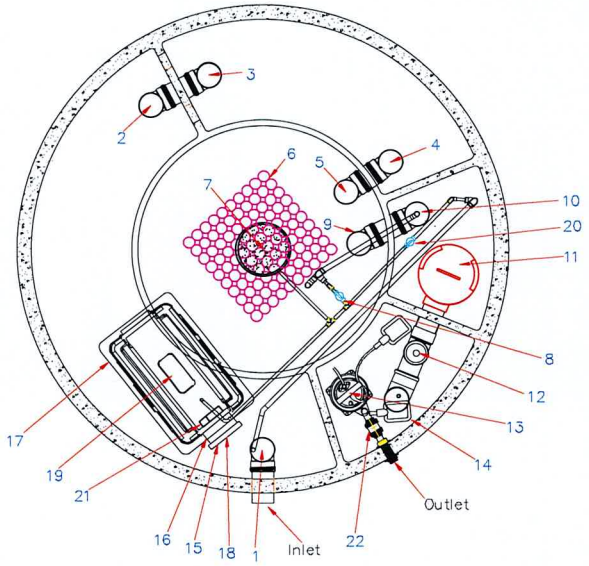
Surface ponding?	☐ Yes	☐ No	
Run off?	☐ Yes	☐ No	
Excess plant growth?	☐ Yes	☐ No	
Effluent leaving premises?	☐ Yes	☐ No	
High risk areas contaminated?*	☐ Yes	☐ No	* Patio, play areas, BBQ, etc
Operating satisfactorily?	☐ Yes	☐ No	If "Not operating satisfactorily" what action was recommended?

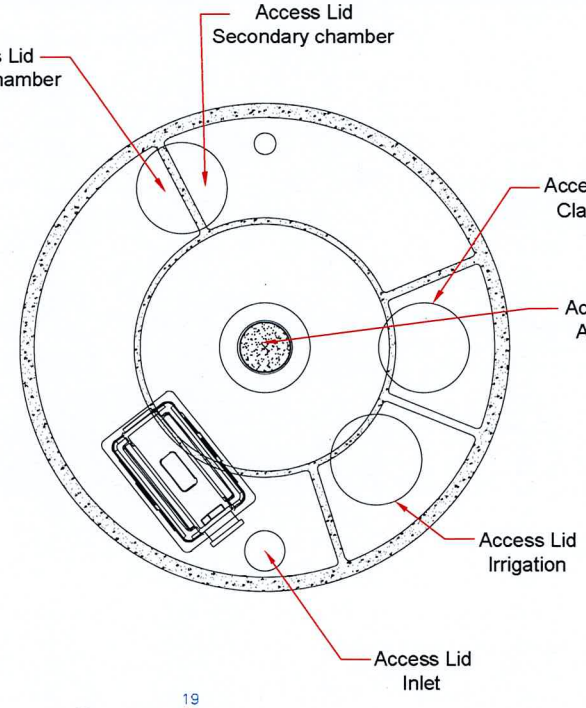
Overall Condition of STS? ☐ Excellent ☐ Good ☐ Fair ☐ Poor
Comments / Action Recommended / Repairs Needed / Repairs Performed:

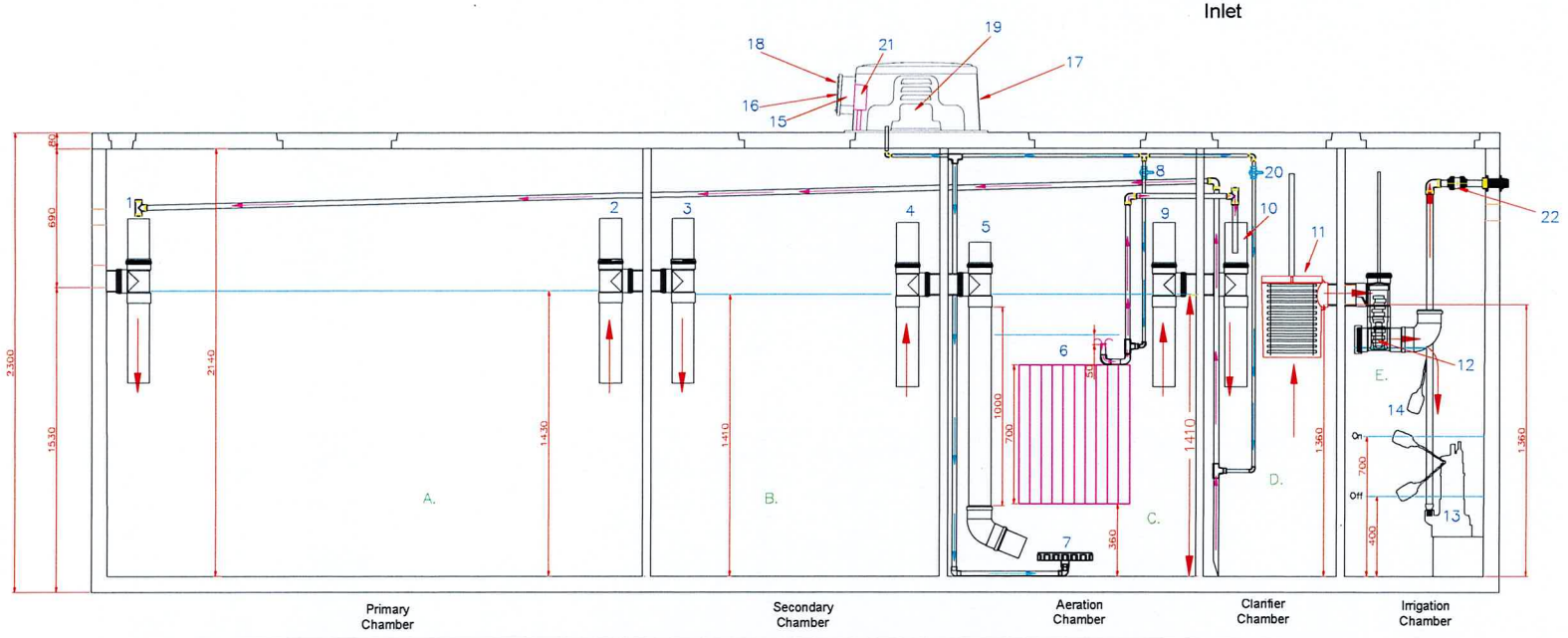
Has the owner / occupier taken recommended actions? ☐ Yes ☐ No

Service Agent:	Contact Details:
Signature:	Date:

Source: Adapted from "Checklist 4.2: Operational AWTS inspection report for use by service providers and Council inspectors" in Designing and Installing On-Site Wastewater Systems, Sydney Catchment Authority, May 2012







TANK DETAILS

TAYLEX CONCRETE ABS 1500

Concrete Tank

A. PRIMARY PRE-TREATMENT CHAMBER	1,684L
B. SECONDARY TREATMENT CHAMBER	842L
C. AERATION CHAMBER	2,071L
D. CLARIFIER	662L
E. CHLORINATION PUMPWELL	621L

WORKING VOLUME 5,880 Litres

TOTAL VOLUME 9,320 Litres

INDEX

1. PVC JUNCTION 100MM X 90
2. PVC JUNCTION 100MM X 90
3. PVC JUNCTION 100MM X 90
4. PVC JUNCTION 100MM X 90
5. PVC JUNCTION 100MM X 90
6. BIO BLOCK
7. DISK DIFFUSER
8. AIR LIFT
9. PVC JUNCTION 100MM X 90
10. PVC JUNCTION 100MM X 90
11. TAYLEX TFG FILTER
12. CHLORINE DISPENSER
13. IRRIGATION PUMP
14. HIGH LEVEL ALARM
15. CONTROL PANEL
16. PANEL BOX
17. BLOWER BOX
18. LIGHT
19. BLOWER
20. SLUDGE RETURN
21. WEATHERPROOF GPO'S
22. NON-RETURN VALVE

ACCREDITED

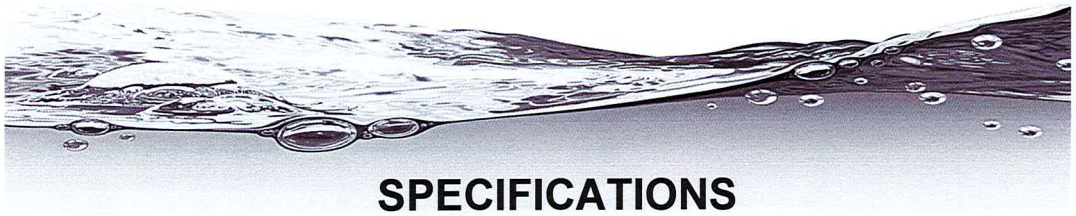
9 OCT 2020

NSW MINISTRY OF HEALTH

Taylex® Tanks Since 1969
Wastewater & Rainwater Specialists

DESIGNED: HH		STATUS: DESIGN	CLIENT: TAYLEX GROUP	PROJECT: ABS CONCRETE 1500	TITLE: TAYLEX CONCRETE ABS 1500
DRAWN: HH		SCALE: NTS			
CHECKED:					
CAD FILE:			Taylex PROJ No.:	DRAWING No.: 1 of 1	SERIES: 2 ISSUE No.:

Taylex® Tanks
Since 1969
Wastewater Specialists



SPECIFICATIONS

CONCRETE
ADVANCED BLOWER SYSTEM 1500
(ABS1500)

TAYLEX® CONCRETE ADVANCED BLOWER SYSTEM 1500

ABS1500

Specifications

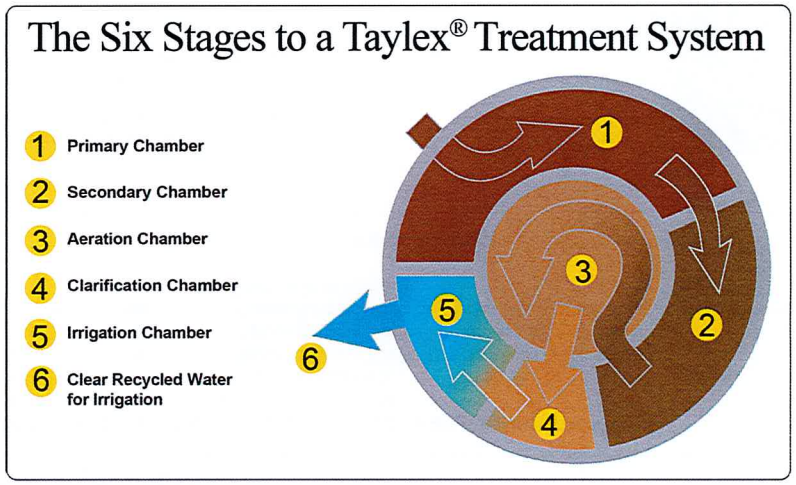
General Description

The Taylex® ABS1500 (Concrete Advanced Blower System 1500) Secondary Treatment System (STS) is designed to treat the wastewater from a residential dwelling up to 1,500 Litres per day, with a daily flow of 150 Litres per person and an average daily BOD^5 70g per person.

The Taylex® ABS1500 STS is contained in one vertical axis type cylindrical precast Concrete collection well with a design capacity of 9,320 Litres and an operating capacity of 5,880 Litres.

Flow path of wastewater:

1. A primary pre-treatment chamber, with a capacity of 1,684 Litres.
2. A secondary pre-treatment chamber, with a capacity of 842 Litres.
3. An aeration chamber, with a capacity of 2,071 Litres. This chamber is fitted with bio block media, 9" disk diffuser and air lift.
4. A sedimentation / clarifier chamber, with a capacity of 662 Litres, containing a Taylex® Disk Filter fitted to the outlet, and a sludge return to the primary.
5. An irrigation chamber, with a capacity of 621 Litres, incorporating a capacity of 300 Litres for chlorine contact of effluent. A chlorine disinfection unit is installed on the inlet to the irrigation chamber. The system is fitted with either a Davey D25 or D42 Irrigation Pump.
6. The automatic irrigation pump transfers the treated effluent to the effluent disposal area / land application area (LAA).



Product Specification Table

Australian Standards Compliance		
Effluent Testing	AS1546.3:2017	
Tank Design and Testing	**In Ground**	AS1546.1:2008
	Above Ground	AS3735:2001
System Model	**ABS1500**	Concrete
Treatment Level	Advanced Secondary	

Tank Capacity	
Total Tank Capacity	9320L
Operating Capacity	5880L

System Chamber Capacities		
Primary Chamber	1684L	
Secondary Chamber	842L	
Aeration Chamber	2071L	
Clarifier Chamber	662L	
Irrigation Chamber	621L	
Maximum Hydraulic Loading Capacity	1,500 litres per day	

Design Parameters		
Parameter	**Total Per Day**	**Total Per person per day**
Daily flow	1500L	150L
Maximum Organic Loading BOD^5	700g	70g
Total Suspended Solids (TSS)	700g	70g
Total Nitrogen (TN)	150g	15g
Total Phosphorus(TP)	25g	2.5g

Effluent Compliance: AS1546.3:2017		
Biochemical Oxygen Demand (BOD^5)	≤10mg/l	
Total Suspended Solids (TSS)	≤10mg/l	
E. Coli	≤10cfu/100ml	

Temperature		
	Minimum	**Maximum**
Operating Temperature C°	-2°C	45°C

Electricity Consumption	
Kilowatt hours per day (kWh/d)	2.21
Kilowatt hours per 1000L (kWh/1000L)	1.62

Servicing and Maintenance	
Servicing Frequency	Every 3 months

Taylex® Tanks Wastewater Specialists
TAYLEX® CONCRETE
ADVANCED BLOWER SYSTEM 1500

COMPONENTS LIST AND REPAIR – REPLACEMENT INSTRUCTIONS

1. Primary Chamber – 100mm inlet Junction
2. Secondary Chamber – 100mm Junction x 2
3. Aeration Chamber – 100mm Junction x 2, BIO Block, Air Lift, Disk Diffuser
4. Clarifier Chamber – 100mm Junction, Taylex® Disk Filter, Sludge Return
5. Irrigation Chamber – 100mm Junction, Chlorine Dispenser, Irrigation Pump, High Level Alarm Float, 100mm Elbow

Component List

TANK

Concrete Tank and Lid
Made from 32mpa concrete with SL 41Mesh

Repair / Replacement Details:
Replacement lids available from Taylex® Industries or your local Service Agents.

Chips and cracks can be repaired using Sika panel patch or mortor.

1) 2) 3) 4) **100mm Sweep Tee With 400mm dropper pipe and 200mm riser**

Repair / Replacement Details:
Replacement tee and pipe can be purchased from a local plumbing store. Cut 100mm pipe at wall and using a 100mm slab repair coupling install new tee.

5) **100mm Sweep Tee With 1000mm dropper pipe and 100mm 45° M&F Bend**

Repair / Replacement Details:
Replacement tee and pipe can be purchased from a local plumbing store. Cut 100mm pipe at wall and using a 100mm slab repair coupling install new tee.

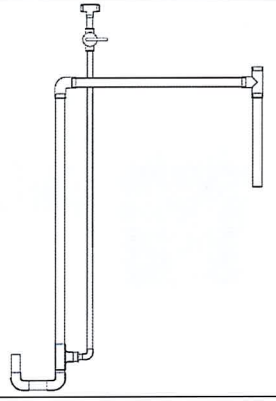
6) **BIO Block Media**
Width - 550mm
Length - 550mm
Height - 700mm
Surface Area - 31.65m^2

7) Diffuser
Material – EPDM
Diameter – 230mm (9inch)

Repair / Replacement Details:
Turn the system off. Replace the diffuser by making a new complete aeration pipe assembly fitted with the Diffuser. Cut the main aeration supply line, place the new diffuser in the system, weighed down with a small concrete block and rotate the diffuser under the biomass. Re fix the new aeration pipe assembly complete with a joining socket. Removing the old Diffuser is not required. Turn the system on. Purchase the complete assembly from Taylex®.

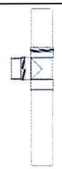
8) Air Lift / Buffer with Control Valve

The Air Lift / Buffer has been specifically designed to provide a buffer within the aeration chamber, to allow increased aeration time and to control the transfer of liquid to the Clarification Chamber. The Control Valve must be set to 55 in order for the buffer to function as designed. Using the 'Venturi Principle', air is injected into the base of the assembly to then lift and transfer the liquid. The specific design will stop when the buffer zone reaches the lower level and then restarts as the water level increases. The volume of the liquid transfer varies proportionally to the liquid level in the Aeration Chamber.



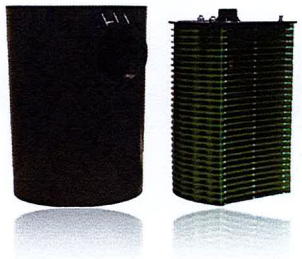
Repair / Replacement Details:
Turn the system off. Replace the Air Lift / Buffer assembly by cutting the main line and installing the new assembly with a joining socket. Turn the system on. Purchase the complete assembly from Taylex®.

9) 10) 100mm Sweep Tee With 400mm dropper pipe and 200mm riser



Repair / Replacement Details:
Replacement tee and pipe can be purchased from a local plumbing store. Cut 100mm pipe at wall and using a 100mm slab repair coupling install new tee.

11) Taylex TFG Disk Filter
Material – A.B.S and Nylon
Height – 400mm
Diameter – 300mm



Repair / Replacement Details:
Replace the TFG filter complete by removing the filter from the housing and inserting the new filter. If Filter Rods require replacement, remove the old rods, one by one, inserting the new rod each time so the filter plates remain assembled. To replace the entire housing, cut and remove the old housing in the transfer pipe, insert a slab repair coupling, re glue and fit the new housing. Ensure the glue is set before re-fitting the TFG filter. Purchase the complete assembly from Taylex®.

Taylex® Tanks
Wastewater Specialists
TAYLEX® CONCRETE
ADVANCED BLOWER SYSTEM 1500

12) Chlorine Dispenser
Material – HD Polyethylene
Length – 360mm
Diameter – 90mm

The chlorine dispenser is placed in the 100mm Tee located in the irrigation chamber.

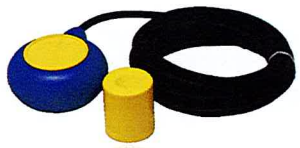
Repair / Replacement Details:
Repairing the Chlorine Dispenser is not recommended. If the Dispenser is damaged, replace it with a new unit. Purchase the complete assembly from Taylex®.

13) Irrigation Pump
The irrigation pump is self-controlled via a ball bearing activated float switch. When the according volume is reached in the pump chamber, the ball bearing in the float moves and creates an active connection.
The treated effluent is pumped to the approved dispersal zone, as the chamber reaches minimum volume, the float drops and de-activates the pump. The type and capacity of the pump will be in accordance with the land application requirements.

Repair / Replacement Details:
Turn the system off. Replace the pump by disconnecting the barrel union, be sure not to drop the internal valve assembly. Lift the Pump Assembly out of the tank. Undo the threaded fitting connect to the outlet of the pump. Re apply thread tape and fix the threaded fitting back onto the pump. Return the assembly to the tank and re-connect the barrel union, ensuring the valve is seated correctly. Turn the system on. Purchase the correct pump from Taylex® or a local outlet, ensuring the performance is identical to the pump removed.

DAVEY D25 – 9m Head	*DAVEY D42A/B3 – 32m Head*
Voltage – 220 ~240 IP 68	Voltage – 220 ~240 IP 68
AMPS – 1.9 Phase 1 50hZ	AMPS – 4.3 Phase 1 50hZ
Max Flow – 200L/min 7m	Max Flow – 130L/min 7m

14) Alarm System High Water
Material – PVC
Length – 20mm
Width - 90mm
Trigger – High Water
Code – 3
Visual – Red L.E.D - 3 Flashes
Audible – Micro Buzzer
Voltage – 12V



Repair / Replacement Details:
Turn the system off. Replace the float by disconnecting the electrical connection in the terminal block, located in the lower section of the control box. Feed the new float cable into the control box and connect to the terminal block, fixing the screws firmly. Re fix the float to the pipe assembly and loop the lead around the barrel union, to set the float height. Turn the system on. Purchase the float from Taylex®.

15) **ECO Control Panel**
(240v to 12V Power Supply)
Length – 160mm
Height – 100mm

The Taylex® ECO is a 12V controller powered by the 240v to 12v power supply plug. As the unit is 12V all works including replacements and repairs do not need to be completed by a Licenced Electrician. All service agents can therefore complete all works within the Control Box and on the Taylex® ECO Controllers.

The Taylex® ECO Controller Assembly (complete with Controller, Control Panel Box, 3 x GPO Assembly and Blower Box) is classed as electrical equipment and has been certified to comply with AS/NZS 3820, meeting the Electrical Safety requirements in Australia and New Zealand

Repair / Replacement Details:
Turn the system off. Replace the Control Panel by removing the 4 screws in the control box. Disconnect the Loom plug from the rear of the panel. Connect the loom to the new panel; return the new Control Panel to the control box and re fix the 4 screws. Turn the system on. Purchase the Control Panel from Taylex®.

16) **Control Panel Box**
Material – HD Polyethylene
Height – 210mm
Length – 190mm
Width – 85mm

The weather proof control box is fixed to the side of the blower box using stainless steel screws. The control panel is fitted to the inside of this box and is connected to the power, high water alarm and pressure switch, via a gland at the back of the box.

Repair / Replacement Details:
Repairing boxes is not recommended. Replacements boxes be purchased from Taylex® or your local service agent.

17) **Blower Box**
Material – HD Polyethylene
Height – 350mm
Length – 600mm
Width – 400mm

The Blower boxed is fitted to the lid of the ABS using 4 x 30mm anchors.

Repair / Replacement Details:
Repairing boxes is not recommended. Replacement boxes can be purchased from Taylex® or your local service agent.

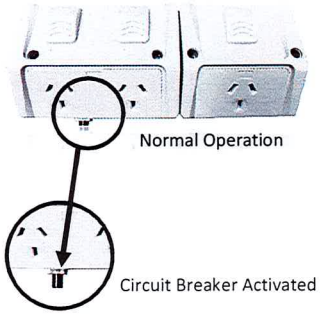
Taylex® Tanks
Wastewater Specialists
TAYLEX® CONCRETE
ADVANCED BLOWER SYSTEM 1500

18) **Weatherproof GPO's**

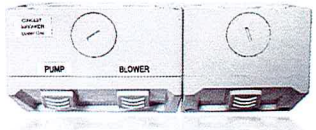
Single	Double
Height – 85mm	Height – 85mm
Length – 85mm	Length – 115mm
Width – 80mm	Width – 80mm

Mains 10amp power is connected through the 25mm coupling provided on the side of the ABS1500 and pulled up through a conduit into the Single GPO. The 12volt power pack plugs into the single GPO to power the control panel. The blower and irrigation pump are plugged into the double GPO.

The double GPO contains a 5amp circuit breaker, which will activate if either the pump or blower (or both) draw too many amps, indicating a fault with the pump or blower. The breaker can be reset by pushing in the button if activated. The systems normal operation including alarms will continue to function, if the breaker is activated.

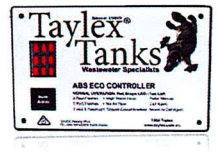


Repair / Replacement Details:
Replacing the GPO's can only be completed by a licenced electrician, please refer to the Taylex® Electrical Connection instructions for details. Replacements can be purchased from Taylex® or your local service agent.



19) **L.E.D Light**
Height – 30mm
Length – 20mm

The LED visual alarm is constructed within the Eco Panel. This LED Red light will flash when an alarm is present. The number of flashes represent the particular code.



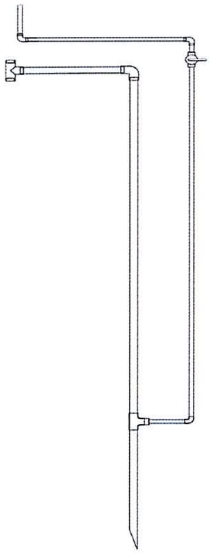
Repair / Replacement Details:
Replacement of the LED lights only is not possible; the complete Control Panel must be replaced. Purchase the Control Panel from Taylex®.

20) **Nitto 80L Blower**
Material – Alloy / Plastic
Height – 180mm
Width – 200mm
Length – 300mm
Weight – 4.9kg
Noise Rating: 40dB(A)
Capacity – 80L
Back Pressure Range – 10kpa – 20kpa
Motor Power – 86 Watts
Power Source – 240V 50hZ

Repair / Replacement Details:
Purchase replacement Blowers and parts from Taylex®.

21) Sludge Recirculation System

This is a typical set up for the transfer of fluids using the 'Venturi Principle'. Air is injected toward the base of a vertical open ended PVC conduit. Continuous displacement occurs as the air moves vertically to the liquid, drawing liquid through the bottom of the conduit. The air/liquid mixture reaches a vertical maximum where it then moves through the 90° bend into the primary chamber. The conduit is arranged in the base of the clarifier so that the residual sludge constitutes the main vacuum target.



Sludge Base Removal
Sludge deposit removal is to be scheduled 1 time per 6 years or as determined necessary by a licenced Taylex® Sales Technician or the client or due to mechanical failure.

Servicing
Routine maintenance/servicing of the Taylex® ABS1500 is to be scheduled quarterly or as determined necessary by an approved Taylex® Sales Technician or due to mechanical failure.
Refer to Field Service Report sheet for testing requirements.

Repair / Replacement Details:
Turn the system off. Replace the Sludge Recirculation Assembly by cutting the main line and installing the new assembly with a joining socket. Turn the system on. Purchase the complete assembly from Taylex®.

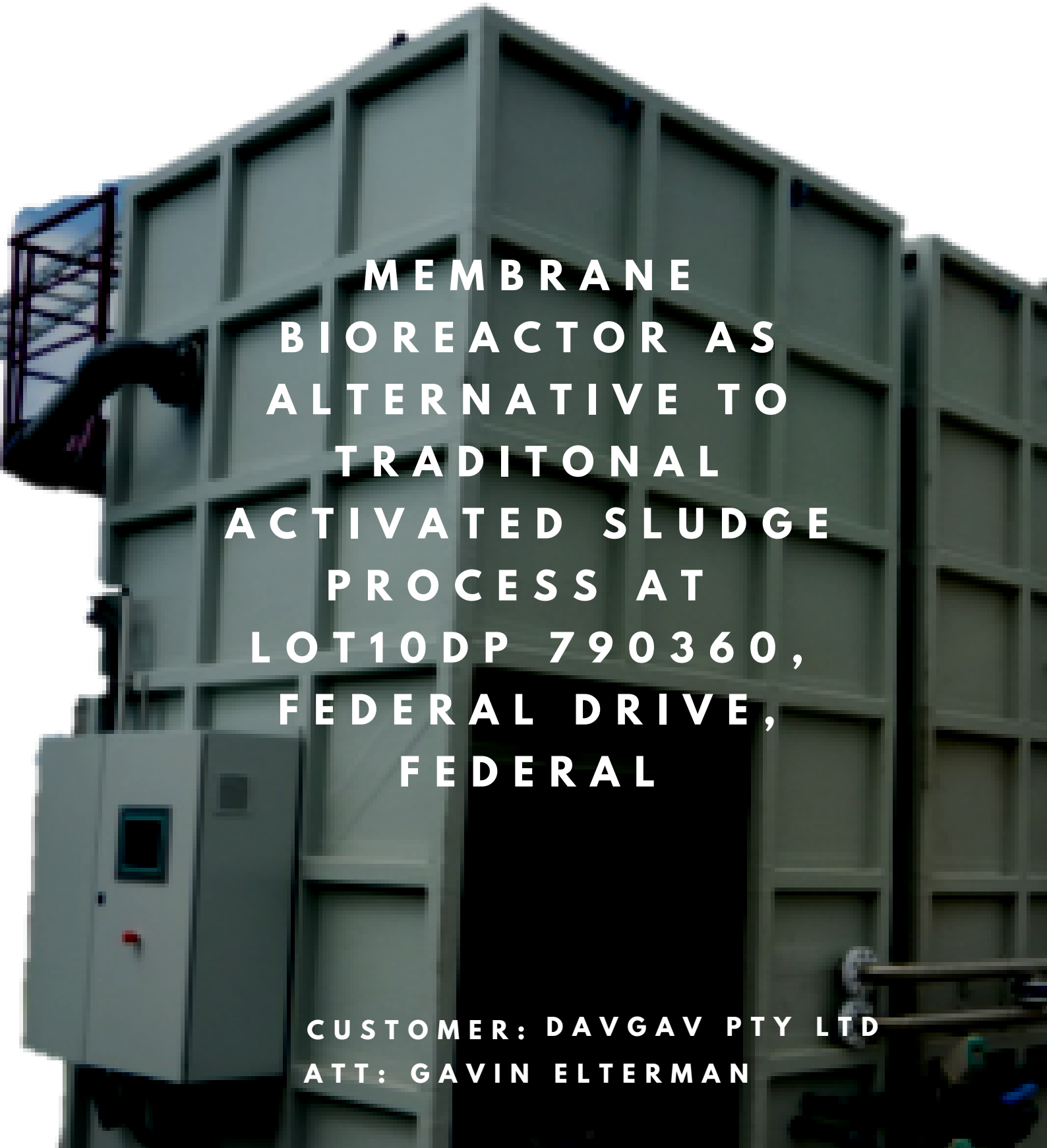
22) Non- Return Valve
Height – 85mm
Length – 140mm
Width – 85mm

Repair / Replacement Details:
Turn the system off. Replace the Non- Return Valve by cutting the pipe in either side of the valve. Re-join the pipe using sockets and glue the Valve and sockets together. Ensure the glue is set before turning the system back on.

18. Appendix H – Example of an Advanced secondary treatment system to treat blackwater

WATERCORE

AUSTRALIAN MADE WATER
TREATMENT AND PURIFICATION



MEMBRANE BIOREACTOR AS ALTERNATIVE TO TRADITONAL ACTIVATED SLUDGE PROCESS AT LOT10DP 790360, FEDERAL DRIVE, FEDERAL

CUSTOMER: DAVGAV PTY LTD
ATT: GAVIN ELTERMAN

INDEX

1. PROPOSAL

MBRs (membrane bioreactors) produce a high-quality effluent that can be discharged to river, ocean, or environmentally sensitive areas, but it can also be recycled for recreational field irrigation, agriculture, artificial waterfalls and recreational pond makeup, nonpotable domestic use, cooling tower makeup, vehicle washing, fire protection, dust control, construction, etc.

A membrane bioreactor is an activated sludge system in which the secondary clarifyer is replaced with a set of microfiltration or ultrafiltration membranes. This technology has been in the market since 1969 and is now widely used in all-size applications.

MBRs are characterised by:

- Small footprint
- Low concern about the reclaimed water quality due to complete suspended solids capture across the membrane
- Lower disinfection dose due to the low turbidity effluent

The use of MBR technology at LOT 10 DP 790360, Federal Drive, Federal, offers an opportunity to implement some of the objectives of the "Australian Guidelines for Water Recycling: Managing Health and Environmental Risk" in a controlled and responsible framework.

Remote monitoring and logging of the most critical process parameters will guarantee a safe operational environment for end-users, underground water bodies and rest of stakeholders

2. BENEFITS

- Recycling the wastewater generated in the complex will reduce concerns about the effluent reaching underground water bodies and its potential impact on existing surrounding bores
- Eliminates the need for a disposal area under the parking
- In-line measurement and 24/7 monitoring of critical performance parameters add a safety net to health and environmental risks

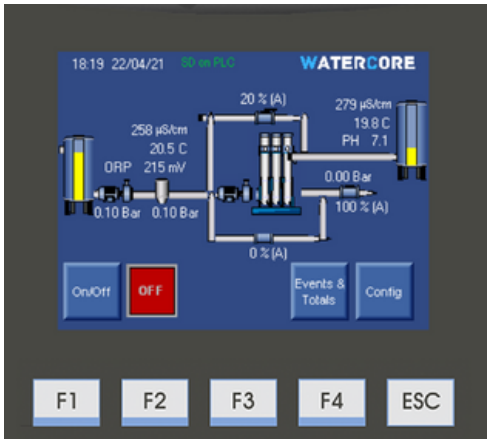
3. TECHNICAL DESCRIPTION

The proposed design will include:

- 1x custom built MBR system
- 1x Microfiltration Submerged Membrane Module with enough capacity for 4KL/day
- 1x Control and Monitoring System for the above elements
- Uneven daily generation and variability of the wastewater intake will be incorporated in the design
- A minimum Solids Retention Time (STR) of 12 days will reduce the risk of membrane fouling

The MBR container will include an integrated PLC control and monitoring system including:

- 3.5" Color Touch Screen
- Remote monitoring and control, with alarms notified by email and/or SMS



4. ANNEX

4.1 WATERCORE MBR TECHNICAL DATA SHEET

4.2 PROPOSED MEMBRANE MODULE

PROCESS DESCRIPTION

Membrane bioreactors (MBR) are activated sludge processes where the final gravity clarifier is replaced with a filtering membrane.

MBRs produce a high-quality effluent that can be discharged to river, ocean, or environmentally sensitive areas, but it can also be recycled for recreational field irrigation, agriculture, artificial waterfalls and recreational pond makeup, nonpotable domestic use, cooling tower makeup, vehicle washing, fire protection, dust control, construction, etc.

MBR SYSTEM BENEFITS

- Excellent effluent quality allows water recycling or direct discharge in sensitive environments
- Small footprint (50% approx.) compared with other activated sludge processes
- Low disinfection doses are required as most bacteria and viruses (>98%) are retained by the membrane

TYPICAL MBR EFFLUENT QUALITY

- Suspended Solids (TSS) < 2 mg/L
- Turbidity < 1 NTU
- COD < 30 mg/L
- BOD < 3 mg/L
- Nitrogen as NH4-N < 1 mg/L
- TN < 5 mg/L
- TP < 1 mg/L
- Faecal coliforms < 100 (count in 100 mL)

MAIN COMPONENTS

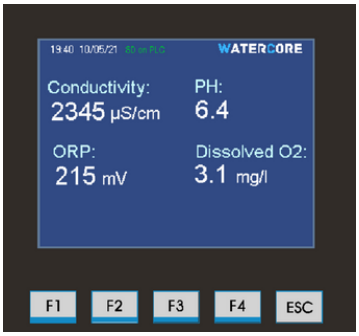
- Equalization Tank: Flow equalization is a crucial step to secure efficient use of the entire system without causing hydraulic or organic overloads. It is sized on a project basis to buffer peak flows.
- Aeration Tank: where various microorganisms cooperate to oxidize biodegradable organics and nitrogen. Approximately 30% to 60% of the carbons in the biodegradable organics are assimilated to live microorganisms while the rest of them are oxidized to CO2. Organic and inorganic nitrogen are also oxidized to nitrate.
- Anoxic tank: removal of nitrogen is enhanced when molecular oxygen (O2) is not present for bacterial respiration and combined oxygen contained in nitrate (NO3 -N) is used as an alternative oxygen source. Molecular nitrogen (N2) is then released.
- Microfiltration Membrane: with a typical pore size of 0.4 microns, the filtration membrane provides a physical barrier to organic and inorganic matter suspended in the water as well as bacteria and viruses.

OPTIONAL COMPONENTS

- Advanced phosphorus removal: more than 80% of the total incoming phosphorus is typically removed by the standard MBR process. When more stringent removal rates are required, alum and ferric coagulants can reduce the phosphorus concentration in effluent down to 0.04 mg/L
- Advanced non-biodegradable COD removal: when influent contains high levels of non-biodegradable COD, PAC can be added to the aeration tank.
- Effluent disinfection (post-treatment): typical MBR virus and bacteria removal is >98%. Additional effluent disinfection can be achieved by chlorination and/or UV.

CRITICAL PLC CONTROLLED PARAMETERS

- Chemical Oxygen Demand (COD): two sensors, located in the influent and effluent sides, compare and log COD values and plant efficiency.
- Dissolved Oxygen (DO): required for biodegradation of BOD and nitrogen, it also represents a 30% of the overall power consumption.
- Oxidation-reduction potential (ORP): used to monitor and control anoxic and anaerobic conditions.
- PH: critical for biological growth



Submerged Microfiltration Membrane Module

HYDRAsub®- MBR — HSM15 w/ HSE15

Module Specifications

Configuration:	Submerged Membrane
Fiber Orientation:	Vertical
Filtrate Flow:	Bi-directional
Membrane Polymer:	Polyvinylidene Flouride (PVDF)
Pore Size (nominal):	0.4 µm
Number of Elements in Module:	1 (15 m² each)
Nominal Membrane Area per Module:	161 ft² (15 m²)
Permeate Connections:	(2)- 2" MNPT
Air Connections:	(2)- 1 1/2" MNPT
Guide Pipe Connections:	(2)- to fit 2.5" pipes

	Typical Dry Weight	Typical Wet Weight
HSM15-ES-HSE15	179 lbs (81 kg)	264 lbs (120 kg)
HSM15-ES15-316	180 lbs (82 kg)	267 lbs (122 kg)

Operating Specifications

Maximum Trans Membrane Pressure (Vacuum):	-6 psig (-0.41 bar)
Maximum Backwash Trans Membrane Pressure:	2 psig (0.14 bar)
Maximum Instantaneous Chlorine Concentration:	5,000 ppm[a]
Maximum Chlorine Tolerance:	742,000 ppm-hrs[b]
MLSS Range:	8,000 - 12,000 mg/L[c]
Operating Temperature Range:	41 - 104°F (5 - 40° C)
Feed Water pH Range:	6.0 - 8.0
Cleaning pH Range:	1.0 - 11.0
Operating Mode:	Outside to Inside

Typical Process Conditions

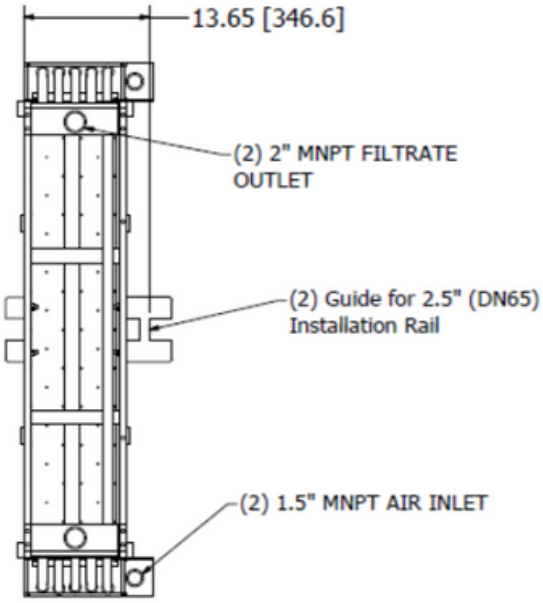
Operating Filtrate Flux†:	4-20 gfd (7-34 lmh)
Peak Operating Flux†:	30 gfd (51 lmh)
Chemically Enhanced Backwash (CEB) Flux:	2.4 gfd (4 lmh)
CEB Chemicals:	NaOCl[d]
Clean In Place (CIP) Flux:	2.4 gfd (4 lmh)
CIP Chemicals:	NaOCl or Citric Acid[d]

† -Depends on temperature and application.
a -For a maximum of 2 hours.
b- Maximum chemical tolerance for estimated life span of membrane.
c -In membrane tank at steady state for municipal wastewater.
d- Refer to operating manual for chemical concentrations and cleaning frequencies.

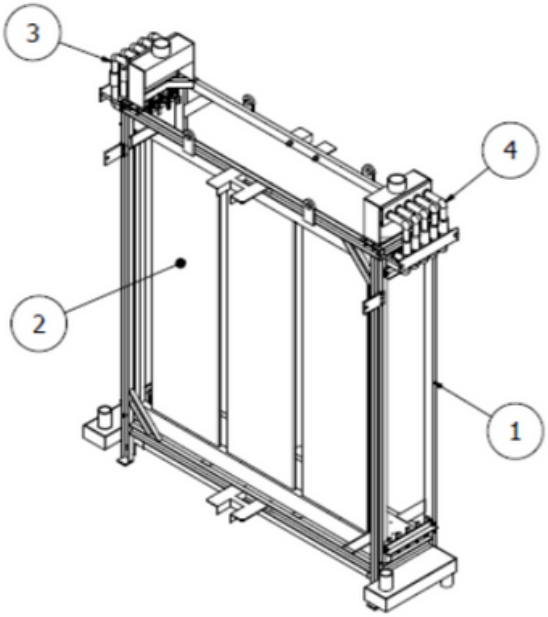
Nitto

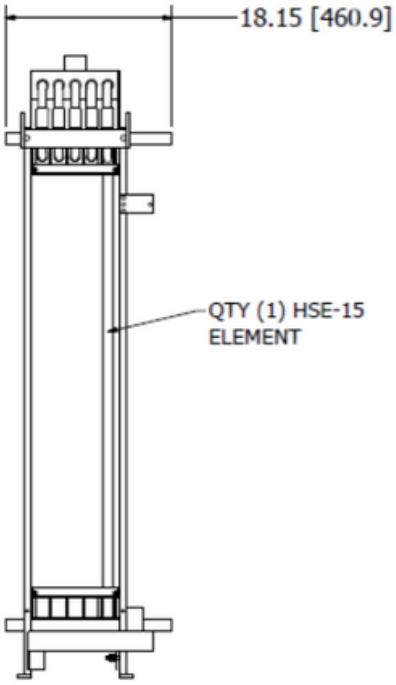
HYDRANAUTICS
Nitto Group Company

Top View

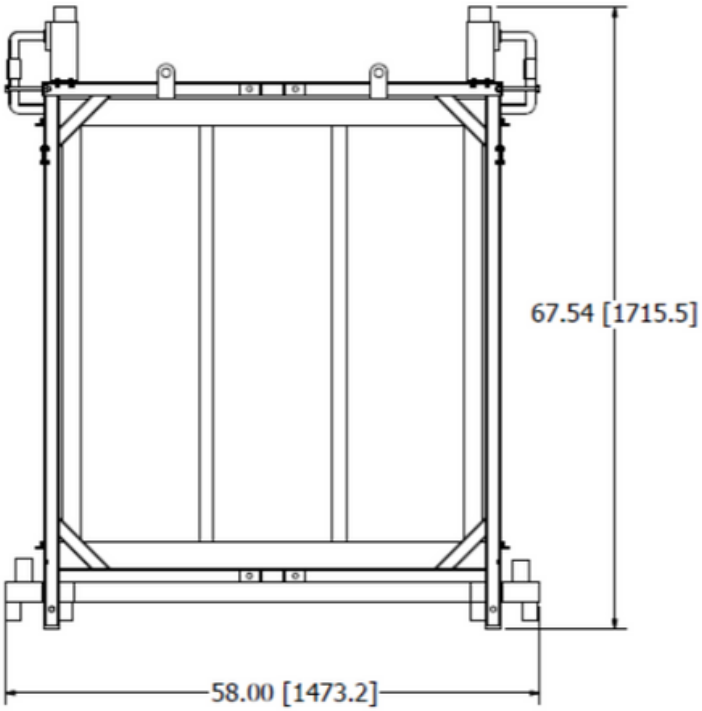


Isometric View





Side View



Front View

Greg Alderson Associates

Greg Alderson and Associates
ABN 58 594 160 789

43 Main Street
Clunes NSW 2480

T +61 2 6629 1552
office@aldersonassociates.com.au
office@edwardsheavylift.com

Civil Engineering

Roads
Driveways
Stormwater
Flooding
Traffic
Earthworks

Structural Engineering

New Structures
Additions and Alterations
Foundations
Wind Bracing & Tie Down
Framing
Retaining Walls
House Plan Drafting
BASIX Certificates

Environmental Assessments

Contaminated Land
Assessments (SEPP 55)
Acoustics &
Noise Assessments
Wastewater
Management
Acid Sulfate Soil