Appendix G16
Preliminary Engineering Design Report

Environmental Impact Statement

for Alterations and Additions to

St Philip's Christian College, Cessnock

NORTHROP

CIVIL

Preliminary Engineering Design Report

for

St Philip's Christian College, Nulkaba NSW

for St Philip's Christian Education Foundation

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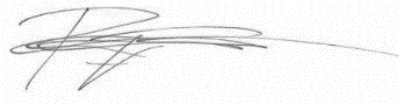

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Contents

1. Introduction

1.1. Background

Northrop Consulting Engineers Pty Ltd has been engaged by St Philip's Christian Education Foundation (the School) to undertake a preliminary engineering design for the proposed works at St Philip's Christian College, Cessnock on Lot 1 DP126765, Lot 1 DP 744377, Lot 2 DP600895 and Lot 518 DP837571, herein known as "the site". The proposal involves alterations and additions to the existing Christian College including new buildings and internal access roads and carparks.

The purpose of this report is to summarise the proposed concept design solutions for the engineering aspects for a State Significant Development Application (SSDA) submission to the NSW Department of Planning, Industry and Environment (NSW DPIE). We note that the information contained in this report is not intended to present detailed design solutions but rather provide solutions proportionate with a conceptual design suitable for SSDA assessment. The report should be read in conjunction with the preliminary engineering design plans NL167397 DA-C01.01 to DA-C07.01, herein referred to as the "civil drawings". The final design solutions and detailed considerations are expected to be undertaken during the detailed design phase.

The report has been prepared to address the SEARs comments, reference SSD-10360337 dated 7 December 2020, considering the objectives and controls of Cessnock City Council's Development Control Plan 2010 (CCC DCP), supporting Technical Manuals, Australian Standards, and industry best practice. The report is intended to form a part of the SSD application and focuses on the following aspects of the SEARs requirements:

- Erosion & Sediment Control (Item 18. Soil and Water).
- Site Grading and Bulk Earthworks.
- Stormwater Management Strategy (Item 16. Stormwater Drainage).
- Sewer and Water Servicing (Item 15. Utilities).

1.2. Site Description

The site is located in the Cessnock City Council (CCC) Local Government Area (LGA), approximately 4km north of the township of Cessnock. The subject site is bound by Wine Country Drive (WCD) to the west, Lomas Lane to the north, Black Creek to the east and a rural property to the south. The site has an area of approximately 42ha and currently contains several school buildings which are predominantly situated on Lot 1 DP126765.

Adjacent to the eastern boundary of the subject site is Black Creek, which runs in a northerly direction, through Lovedale and Huntlee before ending at its confluence with the Hunter River, north of Branxton. Black Creek oxbow, a now isolated section of the original Black Creek alignment, also protrudes into the site, defining the northern, western and southern boundaries of Lot 2 DP 600895. The lower portion of the site, adjacent to Black Creek, is considered floodplain.

Levels on site range from 55.5m AHD at the north-eastern corner to 64.5m AHD in the south-western corner, and generally falls towards Black Creek. Along the western portion, the site slopes gently with grades of approximately 5% and to the east, the grades flatten out closer to the creek.

The main point of access to the site is off Lomas Lane. There is also a secondary gated maintenance access off Wine Country Drive, approximately 230m south of the intersection of Wine Country Drive and Lomas Lane. The site contains several Aboriginal Heritage Potential Archaeological Deposits (PADs), which are predominately located to the west of the site.

An aerial view of the proposed development site is shown in **Figure 1**.

Figure 1 - Aerial image of development site (Nearmap)

2. Proposed Development

2.1. General

The proposed development is to consist of alterations and additions to the existing school. The school caters for students from Kindergarten to Year 12, and also incorporates an Early Education Centre and Prep program as well as a special school for students requiring an alternate learning environment.

The proposed development consists of the following:

- Seven new buildings.
- Additions/ alterations to six existing buildings.
- Alterations to existing northern/western carparks.
- Removal of certain existing prefabricated buildings to make way for new permanent buildings.
- Three new paved carparks.
- Three gravel overflow carparks.
- Stormwater upgrades.
- Service/ sewer upgrades.

The development will be constructed in several stages, which will be outlined during the detailed design stage.

2.2. Major Components of the Development

The proposed development will incorporate the following major civil components:

- Site Regrading –To provide flood immunity to future school buildings, filling of the site is required. The maximum depth of fill is approximately 3.0m above existing surface. A preliminary earthworks design has determined that approximately 24,500m^3 of fill is required. The works will generate 8,220m^3 of cut, meaning 16,280m^3 of material is to be imported.
- Creek Crossings – Stormwater runoff from the existing upstream local catchments, extending to the west of Wine Country Drive, is conveyed beneath Wine Country Drive and continues across the site under existing conditions. The development proposes to install a new formalised road over these drainage paths. As such, two new culvert crossings are proposed to maintain trafficability during storm events.
- Internal Road Network and Carparks – DCP and AS2890 compliant road geometries have been provided to facilitate access for design vehicles (12.5m heavy rigid vehicle).

- Stormwater management – The proposed development includes water quality and quantity management. Waterborne pollutants generated from the site will be managed by Gross Pollutants Traps (GPTs), rainwater tanks and end of line wetlands, sedimentation basins and vegetated swales. Existing pits which outlet to the proposed wetland and sedimentation basins will be retrofitted with in-pit trash racks to remove gross pollutants. The development does not propose any on site detention infrastructure, due to its proximity to Black Creek and small catchment size, relative to the Black Creek Catchment. This is consistent with the previously approved Stormwater Management Report prepared by Worley Parsons in 2009 and the St Phillip's Christian College, 10 Lomas Lane, Nulkaba Flood Impact Assessment (BMT, 2021) prepared by BMT that supplements this SSDA. Retention storage will be provided in rainwater tank storage and the permanent pools of the wetlands and sedimentation basins.
- Water Servicing – Potable water supply to the site will continue via an existing DN150 private connection to the DN300 watermain within Wine Country Drive and a large private DN150 water service connection that supplies the site with potable water.
- Sewer Servicing - The site has an existing private wastewater pump station (WWPS) that discharges to a public wastewater pump station (Nulkaba 1 WWPS). The existing WWPS has been designed to cater for a larger population than currently on site, but not the ultimate school population proposed as part of this SSDA. The population on site is less than the ultimate design capacity of the system and therefore a self dosing mechanism currently pumps clean 5kL water per day into the network to manage septicity and odour issues that would otherwise occur due to low flows. The proposed strategy is to reduce the clean water flows into the system to offset increases due to the increase in population as the school grows. If the measured flows from the development approach the limit of the network, system upgrades may be required, in collaboration with Hunter Water Corporation.
- External intersections – The development proposes the construction of a dedicated site entry directly off Wine Country Drive, as well as upgrade to the Lomas Lane / Wine Country Drive intersection to a multi lane roundabout. Widening of Lomas Lane, along the site frontage, will also be carried out to facilitate the provision of bus bays and a bus layover area. As Wine Country Drive is a State controlled road, TfNSW approval will be required for these works via a Works Authorisation deed during detailed design. Further details of the intersections and population triggers are described in the Traffic Impact Assessment report was prepared by Stantec (Ref: 301400263 (N207200).

3. Erosion and Sediment Control

The proposed development will typically involve stripping, bulk earthworks, service construction (trenching), road/ carpark construction, building construction and shaping of wetlands and channels. These works pose the risk of erosion, sediment and pollutant runoff into adjacent waterways. To avoid this, and comply with Council and legislation requirements, Erosion and Sediment Control practices will be implemented during construction works.

Concept Erosion and Sediment Control Plans have been prepared indicating how compliance with DCP requirements could be achieved. It is expected that these will be further detailed for Construction Certificate and help inform the selected Contractor in development of their own Environmental Management plan. Each plan reflects the extent of physical work and details preventative measures required for construction operations and during the establishment period. Staged erosion and sediment control plans will be provided at detailed design stage, reflecting the progressive sequence of protection for each stage.

3.1. General Design Requirements

In general, soil and water management required during construction and establishment periods shall be undertaken in line with the requirements outlined in ‘Managing Urban Stormwater, Soils and Construction’ (The Blue Book) prepared by Landcom and Cessnock City Council’s design and construction policies. As a general guide, the following principles shall be employed with the aim to minimise soil disturbance and erosion and where such disturbance is required to prevent migration and deposition onto neighbouring property and water courses. Some of the general principles which shall be employed are included below.

3.1.1. Prior to Construction Commencing

A copy of the approved Soil and Water Management Plan shall be kept onsite and made available to all construction personnel at all times.

As part of general site induction, all personnel shall be made aware of the general intent as well as the specific requirements/ mitigation measures of the soil and water management plan.

A maintenance schedule for all mitigation measures shall be developed and implemented.

Areas where the existing vegetation is proposed to be retained or Aboriginal Heritage PADs shall be designated as ‘No-Go’ areas and appropriate protective fencing shall be erected to prevent unauthorized access by vehicles and personnel.

Install sediment protection filters on all new and existing stormwater inlet pits in accordance with either the mesh and gravel inlet filter detail SD6-11 or the geotextile inlet filter detail SD6-12 of the 'Blue Book'.

Install sediment fencing around individual work zones/areas which require specific protection or have a higher potential for erosion.

Establish all sediment fences along site work boundaries or topographical features in accordance with detail SD6-8 of the 'Blue Book'.

Earth diversion mounds/ swales shall be constructed to divert clean stormwater around undisturbed areas as well as collect potentially sediment laden runoff from upslope disturbed areas. Diversion systems shall be constructed from swale side-cast on down slope.

3.1.2. During Construction Activities

The contractor shall ensure that all vegetation (tree, shrub and ground cover) which is to be retained shall be protected during the duration of construction.

All trees to be removed shall be mulched onsite and spread/ stockpiled or opted for reuse as sediment filters in lieu of sediment fencing or protective ground cover/ stabilisation for disturbed areas to be revegetated.

All trenches shall be side-cast to the high side and closed at the end of each day's work.

Strip topsoil in areas designated for stripping and stockpile for re-use as required. Any surplus material shall be removed from site and disposed of in accordance with EPA guidelines.

Construct and maintain all material stockpiles in accordance with detail SD4-1 of the 'Blue Book' (including cut-off swales to the high side and sediment fences to the low side) and provide wind and rain erosion protection as required in accordance with detail SD6-12 of the 'Blue Book'.

Provide water trucks or sprinkler devices during construction as required to suppress dust throughout the construction operations.

Once cut/ fill operations have been finalised, all disturbed areas that are not being worked on shall be re-vegetated as soon as is practical, either temporarily or permanently in accordance with the landscape design.

The contractor shall keep a detailed written record of all erosion and sediment controls on-site during the construction period. This record shall be updated daily and shall contain details on the condition of controls and any/ all maintenance, cleaning and breaches. This record shall be kept on-site at all times and shall be made available for inspection by the principal certifying authority and the Superintendent during normal working hours.

Water captured within the sediment basin during construction shall be managed and discharged in accordance with the Sediment Basin Dewatering Procedure outlined below.

3.1.3. After Completion of Construction Works

Environmental management controls shall be maintained in good order until the site is deemed sufficiently stabilized. For areas of bulk earthworks, minimum 90% ground cover should be achieved for the extent of works prior to decommissioning of temporary sediment basins or removal of controls.

Temporary protection of permanent wetlands and bioretention basins should be kept in place until at least 90% of dwelling construction has been completed, and verge and landscape areas achieve 90% cover.

All environmental management devices should be cleaned and removed of sediment and pollutants to a suitable disposal location prior to removal.

4. Site Grading and Bulk Earthworks

4.1. General

The site is subject to flood inundation during local and regional flood events. To provide flood immunity to future school buildings, filling of parts of the site is required. A 2D flood assessment was undertaken by BMT for the site as part of this SSDA which is detailed in a separate report. The assessment determined flood levels in a 1% Annual Exceedance Probability (AEP) storm event. A minimum 500mm freeboard allowance was added to this level to determine the Flood Planning Level for the development, refer to BMT's Flood Impact Assessment for further details.

A 3D data terrain model (DTM) of the proposed site was modelled to determine fill depths/extents and volume required to achieve flood immunity. Additionally, the 3D model was assessed to ensure there were no proposed earthwork impacts on surrounding Aboriginal Heritage PADs. The maximum depth of cut is approximately 3.0m and the maximum depth of fill is approximately 3.0m as shown in the civil earthworks drawings. It shall be noted that the majority of areas in cut are not affected by flooding. In addition to flood levels, consideration was given to the following as part of the bulk earthworks and grading design:

- Longitudinal grading for the proposed internal road networks is generally 0.5-1%, ensuring an absolute minimum of 0.5% and maximum of 8% longitudinal grade.
- Grading for proposed carparks comply with AS2890 and generally have a total fall of 1-2%.
- Grading for gravity drainage of stormwater. Generally, a minimum fall of 1% was adopted across the site.
- Interface with surrounding undeveloped land. Generally, a 1V:4H batter has been adopted, however in some areas retaining walls are proposed up to approximately 2m.

The civil drawings depict the proposed extent of cut and fill and surface grading across the site. Based on a design surface to existing surface volume calculation, it is anticipated that 8,220m³ of cut and 24,500m³ of fill will be required to achieve the proposed design levels. To achieve a balance, approximately 16,280m³ of imported fill material will be required. The preliminary earthworks model assumes a road and carpark pavement depth of 450mm and a building pad depth of 150mm. The model does not take into account topsoil, landscaping, service trenches, bulking factors, unsuitable material (for reuse), excavation from behind retaining walls or building footings etc, which will likely reduce the volume of import required.

5. Stormwater Management Strategy

5.1. General Philosophy

The proposed Integrated Water Cycle Management Plan incorporates both water quality and quantity measures to manage stormwater runoff from the proposed development site.

The strategy presented herein, is based on the previously approved Worley Parson's Stormwater Management Report (2009). Amendments to the previous strategy are proposed to accommodate the additions and alterations to the school.

It is proposed to modify the existing basins/ wetland areas which were sized for a smaller development footprint. These modifications will ensure that current industry best practices are adopted for the site and that the proposed stormwater management basins are sized to achieve stormwater quality requirements. By adopting a similar design intent to the current stormwater management strategy, the majority of the existing stormwater network can be maintained and utilised.

Similar to the previously approved strategy detailed in the Worley Parson's report, the development proposes retention in lieu of on-site detention, as detailed in Section 5.4 below.

5.2. Minor/ Major Stormwater Conveyance

Runoff generated during a minor storm event is to be conveyed via the below ground piped drainage system to Black Creek via a water quality treatment system. Stormwater runoff from gravel roads and carparks is to be conveyed via vegetated swales to Black Creek. The proposed below ground network will be sized to convey the 10% AEP storm event, in line with Council guidelines. The existing stormwater network will be utilised where appropriate.

Runoff during major storm events (including the 1% AEP storm event) is proposed to be conveyed via a combination of the below ground network, road carriageways, and swales/ channels.

Concept stormwater management plans have been prepared for the proposed development showing concept minor and major drainage networks. Please refer to the Civil drawings for more information.

5.3. Creek Crossings

There are two proposed creek crossings on the subject site as shown in Figure 1 in Appendix B. Culvert A is situated within the site, adjacent to Wine Country Drive (WCD), approximately 300m south of Lomas Lane. There is an existing informal culvert crossing in this location which is proposed to be upgraded to enable raising of the internal road network to meet regional Black Creek flooding conditions.

Culvert B is also proposed across the new internal access driveway, located in the southern portion of the subject site. Upgrades to the existing informal channel extending from Wine Country Drive to Black Creek are also proposed.

A preliminary hydraulic investigation was conducted to review the capacity of the proposed Culverts A and B, as shown in Figure 1 in Appendix B. A DRAINS model has been prepared to assess the quantity of stormwater runoff generated by the upstream catchments and to provide a preliminary sizing of the infrastructure. It is anticipated the design of this infrastructure will be further refined during future detailed design project phases.

Below is a summary of the catchments and infrastructure considered in the study, the model parameters used, and the results from the investigation.

5.3.1. Study Catchments

Two catchments have been digitised for the study which are based on available LiDAR elevation data as presented in Figure 2 in Appendix B. The catchment size and assumed impervious fractions are presented in Table 1. Although aerial imagery suggests the majority of C02 remains undeveloped at the time of preparation of this study, this area has been earmarked for re-development and as such, a minimum 65% impervious fraction has been assumed over the residential land use in this area. This is considered a conservative assumption as detention is likely to be installed in this area, upstream of Wine Country Drive. When considering the existing road and petrol station as well as the future development, the total impervious fraction of C02 is 70%.

Table 1 – Catchment Parameters

Catchment	Area (ha)	Percentage Impervious (%)	Average Slope (%)
C01	29.85	5	5
C02	15.49	70	6

Sheet flow time of concentration has been estimated using the Kinematic Wave Equation while, concentrated flow for rural and urban areas was based on Tables 4.6.6 and Figure 4.5 of QUDM respectively.

5.3.2. Storm Losses

The latest Australian Rainfall and Runoff 2019 (AR&R 2019) guidelines have been used for the investigation. This includes the Initial and Continuing Loss model and the use of the latest NSW specific Probability Neutral Burst Losses.

Storm losses used for this investigation have been obtained from the AR&R Data Hub. Storm losses provided by the AR&R Data Hub are intended for rural catchments. As a portion of the study catchment has been urbanised, additional reductions to the pervious initial losses have been applied over these areas as shown in the below Table 2. Urban pervious initial losses have also been reduced by a factor of 0.7, representing a reduced initial loss (when compared to rural catchments) generally in accordance with the latest ARR 2019 guidelines. Similarly, modelled continuing losses have been reduced by a factor of 0.4 in accordance with the advice provided in the latest Department of Primary Industry and Environment (DPIE) guidelines.

Table 2: Adopted DRAINS Rainfall Loss Rates

Land-Use	Initial Loss (mm)	Continuing Loss (mm/hr)
Rural Pervious (ARR Data Hub)	27.0	2.9
Urban Pervious (Modelled)	18.9	1.16
Urban Impervious (Modelled)	1.5	0

5.3.3. Burst Rainfall Data

Rainfall Intensity-Frequency–Duration (IFD) depths for the ARR 2019 have been obtained from the Bureau of Meteorology (BOM) for a location over the catchment centroid. The “East-Coast South” temporal patterns have been adopted for the ARR 2019 hydrology.

5.3.4. Pre-Burst Rainfall Data

The latest NSW Specific Transformational pre-burst depths have been added from the AR&R Data Hub to the design rainfall events. The model was run for a range of storm events including storm durations between 10 minutes and 3 hours. When combined with the initial losses presented in Table 2 above, the Transformational pre-burst depths generate the Probability Neutral Burst Initial Losses as recommended by the latest NSW guidelines.

5.3.5. Infrastructure

Under existing conditions, Culvert A consists of four 1.2m wide, 0.6m high box culverts. Underdeveloped conditions, it is proposed to install an additional four barrels to ensure the maximum upstream water level matched pre to post. This was to ensure tailwater conditions to Culvert 1 and freeboard to Wine Country Drive was not impacted as a result of the raised road levels.

Culvert B was modelled in the developed case and sized with a minimum of 0.5m freeboard during the 1% AEP, permitting access along this road during both the local and regional 1% AEP flood event. Six 1.5m wide by 0.75m high box culverts are proposed beneath the road network, along with formalised channel both upstream and downstream of the proposed crossing.

A blockage factor of 25% has been applied to both the existing and proposed culverts which is based on an assessment using the latest AR&R guidelines.

Tailwater conditions were based on flood levels provided by BMT and extracted from the St Phillip's Christian College, 10 Lomas Lane, Nulkaba Flood Impact Assessment (BMT, 2021). The 5% AEP Black Creek flood levels were used as the tailwater conditions for the crossing design. This is considered appropriate due to the low likelihood of a coincident 1% AEP regional and local storm event.

5.3.6. Results

Culvert A

An assessment of the water level on the upstream side of Culvert A has been performed to review potential impacts to Wine Country Drive. The results of the investigation is shown in the below **Table 3**.

Table 3 - Pre to Post Peak Water Level Comparison (Culvert A)

Return Interval (AEP)	Existing (mAHD)	Developed (mAHD)	Difference (mAHD)
1%	58.78	58.79	+0.01

The results presented in the above **Table 3** demonstrate, during the post developed case there is up to a 10mm increase in the upstream water level. This is not expected to create a significant adverse impact on Wine Country Drive.

The top of the proposed road level at this culvert crossing is 59.25m AHD, suggesting approximately 460mm freeboard is available during the 1% AEP. It is noted less than 500mm freeboard to the 1% AEP is proposed. There is a limited opportunity to increase freeboard in this area due to the high tailwater conditions in Black Creek (limiting any benefit from additional culverts) and the increased risk of flooding in WCD during severe blockage (100%) conditions (if raising the road level).

Culvert B

The freeboard available on the upstream side of Culvert B crossing has also been assessed as part of this investigation. A spill level across the proposed road has been estimated based on the design surface. The results are presented in the below **Table 4.**

Table 4 - Culverts and Freeboard (Culvert B)

Road Spill Level (m AHD)	1% AEP Water Level (m AHD)	Freeboard (mm)
59.75	59.22	530

The results presented in Table 4 suggest a minimum of 530mm freeboard is available for Culvert B, which is greater than a typical freeboard of 500mm. Impacts to WCD are not expected in this location as the proposed road level of 59.75m AHD is lower than the Culvert 2 downstream invert level of 60.54m AHD. This suggests that in the event of severe blockage (100%) at the proposed Culvert B more than 750mm is available before tailwater conditions are induced at WCD. Furthermore, under design conditions (i.e. 25% Blockage at Culvert B), more than 1.3m freeboard is available to the Culvert 2 downstream invert.

5.4. Onsite Stormwater Detention

As previously mentioned, Worley Parson's prepared a Stormwater Management Report for the establishment of the Cessnock Campus at the site in 2009. This report states that onsite detention is not required for the development due to the site's proximity to Black Creek.

The site is a small local catchment within the Black Creek Catchment and is situated within the Black Creek Floodplain. As such, the site has a significantly smaller time of concentration compared to the Black Creek Catchment and therefore any peak flow attenuation provided through onsite detention would reduce post developed flows in the early stages of a flood event and have no major impact during the peak of the event. Consequently, there is little benefit in providing onsite detention for the major storm events.

The development proposes the construction of new buildings and internal roadways and carparks. As such, there will be an increase in impervious area across the site which may result in an increase in the frequency of low return period events. To account for this, a minimum 25mm retention storage per unit area of impervious surface has been integrated into the rainwater tank storage and permanent pond volume of the proposed basins. Rain tank sizing is described further in Section 5.5.5.

5.5. Stormwater Quality

Water quality treatment has been assessed generally in accordance with Cessnock City Council's Development Control Plan and Technical Manuals. To substantiate the effectiveness of the proposed water quality control measures, stormwater quality modelling was undertaken using the Model for Urban Stormwater Improvement and Conceptualisation (MUSIC) V6.3.0.

5.5.1. Treatment Targets

Stormwater quality is proposed to be managed through a treatment train approach to meet pollutant removal efficiency targets. Preliminary liaison was undertaken with Council's Principal Development Engineer, who confirmed the following treatment targets for stormwater runoff:

Table 5 - Reduction targets for pollutants

Pollutant	Reduction Target
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	45%
Total Nitrogen (TN)	45%

5.5.2. Stormwater Catchments

The topography of the development generally falls eastwards towards Black Creek which runs from south to north along the site's eastern boundary and also protrudes into the site, bounding the existing sporting fields. As such, the stormwater catchments are proposed to discharge to this creek. **Figure 2** shows the indicative extents of each stormwater catchment within the proposed development.

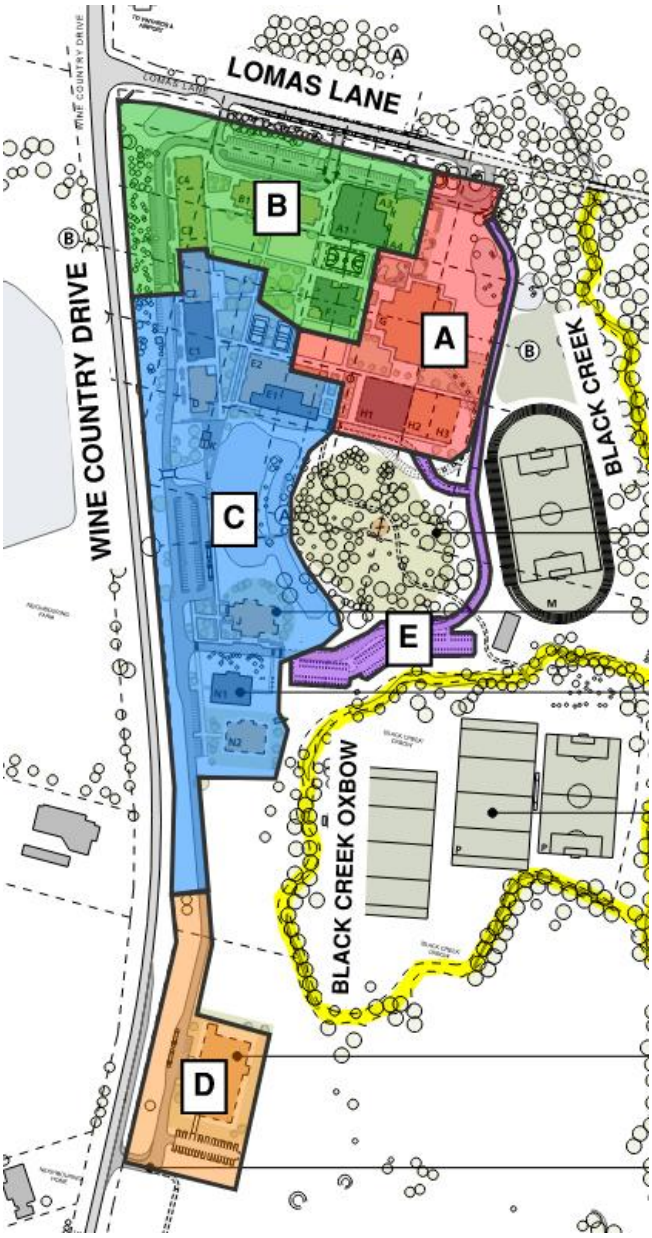


Figure 2 – Indicative extent of internal stormwater catchments

The above stormwater catchments consider the existing topography of the development, as well as the site grading of the proposed works.

5.5.3. Meteorological Data

Meteorological data was obtained from the MUSIC website and set up using the meteorological template build tool. Rainfall data for the Pokolbin (Somerset) weather station (number 061238) was used for a continuous period from January 1990 to March 2010 with a six-minute time step. The monthly areal potential evapotranspiration (PET) rates adopted for the model were from Newcastle, sourced via the MUSIC software package, and shown in **Table 6**.

Table 6 – Adopted Monthly Areal Potential Evapotranspiration Rates

Month	Areal Potential Evapotranspiration (mm/month)
January	188
February	148
March	148
April	96
May	66
June	53
July	56
August	72
September	100
October	138
November	162
December	180

The rainfall and evapotranspiration time-series graph used for the MUSIC modelling is shown below in **Figure 3**.

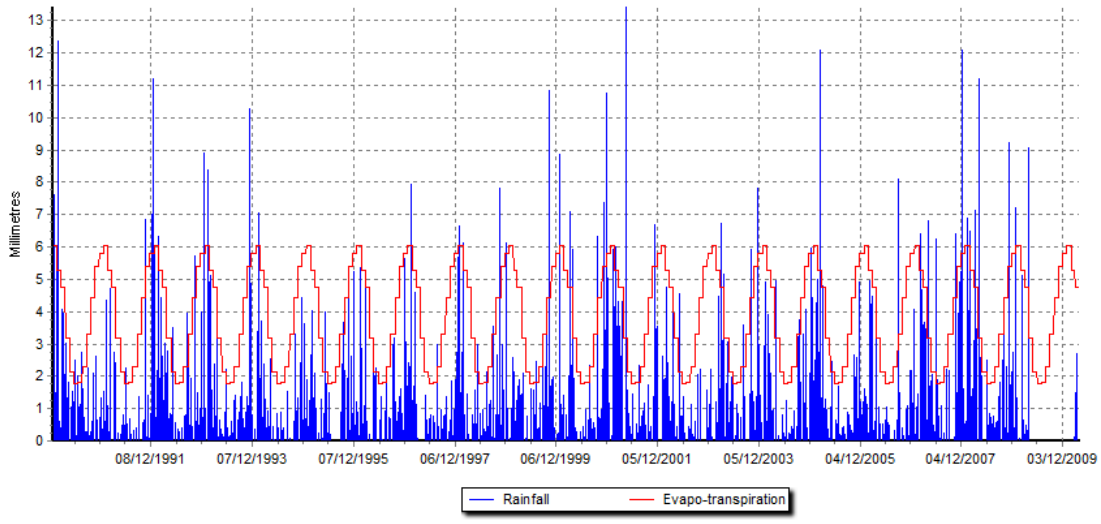


Figure 3 – Rainfall and Evapo-Transpiration Graph

5.5.4. Catchment Parameters

Rainfall-runoff parameters for silty clay loam as detailed in the 2015 NSW MUSIC Modelling Guidelines were adopted for modelling, based on the soil classification from the Preliminary Geotechnical Investigation by RCA Australia (REF 15613-202/1). These parameters are shown in **Table 7**.

Table 7 – MUSIC Rainfall-Runoff Parameters

Soil storage capacity (mm)	88
Initial storage (%)	25
Field capacity (mm)	70
Infiltration capacity coefficient – a	180
Infiltration capacity coefficient – b	3
Initial depth (mm)	10
Daily recharge rate (%)	25
Daily baseflow rate (%)	25
Daily deep seepage rate (%)	0

5.5.5. Stormwater Treatment Train

Stormwater runoff from each catchment was divided into multiple source nodes to be modelled in MUSIC. The source nodes adopted to represent the development were Urban Roof, Urban Sealed Road for internal carparks and roads, Urban Unsealed Road for gravel carparks and roads, Urban Revegetated Land for landscaped areas, and Urban Mixed for the remaining impervious areas including footpaths, sports courts etc. The pollutant load parameters were set in accordance with the default MUSIC values for the corresponding source node.

The above source nodes were modelled for each catchment. Treatment nodes were created within the MUSIC model to represent the water quality treatment devices. A description of each of these measures is included below.

- Rainwater reuse tanks (Aquatic Centre) – Runoff from the roof area will be collected and diverted to a total minimum storage volume of 40kL. Each tank is to be fitted with proprietary first flush devices, which capture the first portion of runoff from the roof, to effectively remove sediment and attached pollutants. The rainwater harvesting system has been modelled with an internal reuse parameter for toilet flushing and an external reuse parameter for landscape irrigation. It was assumed that the Aquatic Centre would have a daily demand of 0.6kL (equivalent of 10 flushes per toilet per day) and an annual demand of 440kL for landscape irrigation. The node water balance tool in MUSIC was used to ensure a minimum reuse demand (75%) was met for each rainwater harvesting system. Overflow runoff from the rainwater tanks will be directed to the pit and pipe network which conveys stormwater runoff to Black Creek via a vegetated swale.
- Rainwater reuse tanks (All other buildings) - Runoff from 100% of roof areas (both existing and proposed) will be collected and diverted to a combined total minimum storage volume of 215kL. Each tank is to be fitted with proprietary first flush devices, which capture the first portion of runoff from the roof, to effectively remove sediment and attached pollutants. Each rainwater tank has been modelled with an internal reuse parameter for toilet flushing. It was assumed that the daily demand per student/ staff member would be 2 x 3L flushes and 1 x 6L flush or 12L per person, per school day. The total number of students and staff predicted for

2031 is approximately 1950. Given there are approximately 200 school days in a year, the average internal reuse demand for the school site is 12.8kL/day. The node water balance tool in MUSIC was used to ensure a minimum reuse demand (75%) was met for each rainwater harvesting system. Overflow runoff from the rainwater tanks will be directed to the pit and pipe network.

- Gross Pollutant Traps (GPT) - A proprietary GPT has been proposed at the outlets of Catchment B and C to remove gross pollutants and attached nutrients before runoff discharges into the proposed wetland and sedimentation basin, respectively.
- Pit Inserts- Existing pits within the existing carpark in Catchment B are to be retrofitted with proprietary filter baskets (OceanGuard or similar) to remove gross pollutants from runoff prior to discharge into the vegetated swale. Pits within the road/ carpark at the Aquatic Centre and in Catchment C are also to be fitted with filter baskets. Existing pits which outlet to the proposed sedimentation basin in Catchment A will be retrofitted with in-pit trash racks.
- Sedimentation basin – the existing basins in Catchment A and C are proposed to remain and be reshaped as required. These ponds were modelled as sedimentation basins in MUSIC. Parameters for the sedimentation basins were adopted in accordance with the “NSW MUSIC Modelling Guidelines” (BMT WBM, 2015). The sedimentation basins for Catchment A and C were modelled with surface areas of 400m^2 and 1500m^2, respectively, and permanent pool volumes of 280m^3 and 1050m^3, respectively. Each pond was modelled with an extended detention depth of 200mm. Vegetation would be established on the batters and base to convert the basin into a pond system. Flow out of the pipe and overflow weir will be directed to Black Creek.
- Bioretention basin – To attain the stormwater quality targets, a bioretention basin is to be located within the landscaping areas to the east of the carpark in Catchment C. Stormwater runoff in the carpark areas will be directed to the bioretention trench where, through infiltration, it will collect and treat stormwater runoff from the proposed development, before piping treated stormwater to the proposed sedimentation basin. The bioretention basin has been modelled with a filter area of 280m^2, surface area of 350m^2, filter depth of 0.4m and an extended detention depth of 0.2m. Parameters for the bioretention basin were adopted in accordance with the “NSW MUSIC Modelling Guidelines” (BMT WBM, 2015).
- Wetland - To attain the stormwater quality targets, the existing basin in Catchment B will be reshaped and vegetated to form a wetland system. The wetland was modelled with an inlet pond (a deep sedimentation basin to remove coarse sediments and regulate flows) and a macrophyte zone (a shallow, vegetated area to remove fine particulates and uptake nutrients). The wetland will be constructed with a high flow bypass channel to protect the macrophyte zone from vegetation damage and scour. Treated stormwater runoff from the wetland will discharge to Black Creek via a vegetated swale. The macrophyte zone was modelled with an extended detention depth of 0.4m, permanent pool depth of 0.3m and volume of 180m^3, inlet pond volume of 30m^3 and 600m^2 surface area for the macrophyte zone. Parameters for the wetlands were adopted in accordance with the NSW MUSIC Guidelines (BMT WBM, 2015).
- Vegetated swale - Runoff from the gravel roads and carparks is to be collected and directed to Black Creek via vegetated swales. The established vegetation within the swales will filter the runoff to provide removal of coarse and medium sediments. Runoff from Catchment A, B and D will also be collected and directed to Black Creek via end of line vegetated swales.

A key objective of the proposed stormwater treatment train is to utilise the existing water bodies already on site, which were constructed as part of a previous approval. Due to the increase in development footprint when compared against the previously approved scheme, additional controls have been added to maintain compliance with water quality treatment objectives.

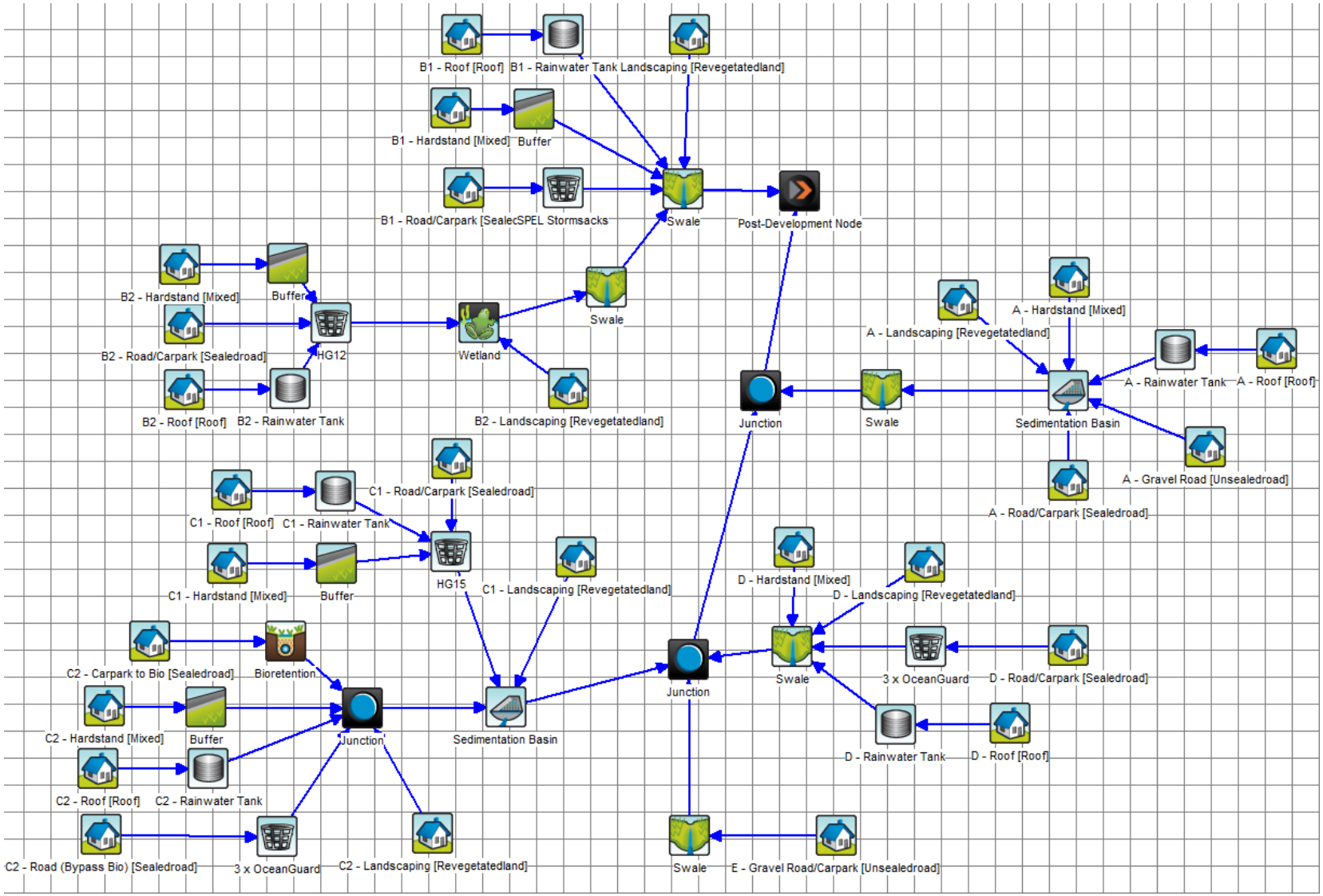


Figure 4 – MUSIC Model Layout Schematic

5.5.6. MUSIC Results

A schematic of the MUSIC model can be seen in **Figure 4** on the previous page. The results from the site analysis are shown below in **Table 8.**

Table 8 - Sitewide MUSIC results – Post Development Node

POLLUTANTS		SOURCES	RESIDUAL LOAD	REDUCTION (%)	REDUCTION TARGET (%)
Total Suspended Solids (TSS)	kg/yr	10600	1430	86.5	80
Total Phosphorus (TP)	kg/yr	15.2	4.99	67.3	45
Total Nitrogen (TN)	kg/yr	103	56.5	45.1	45
Gross Pollutants (GP)	kg/yr	1210	6.57	99.5	-

Table 8 shows that the proposed stormwater management strategy is predicted to achieve the load reduction targets, as estimated by MUSIC.

Through adoption of the above measures, it is considered that the proposed treatment train will effectively meet the design intent of CCC's water quality requirements. Ongoing maintenance of the implemented measures throughout the occupational phase of the development will be required to ensure the devices continue to operate as intended.

6. Sewer and Water Servicing

Hunter Water Corporation (HWC) have provided preliminary servicing advice for the proposed expansion at SPCC (Appendix C). After further consultation with HWC, the advice can be summarised as follows.

6.1. Water Servicing

The site has an existing frontage to a DN300 watermain located within Wine Country Drive and a private DN150 water service connection that supplies the site with potable water. There are no Hunter Water requirements to upgrade any HWC infrastructure.

As part of the detailed design, the suitability of the existing private connection should be confirmed as part of a Hydraulic Assessment and associated Technical Services application to HWC.

6.2. Wastewater Servicing

The site has an existing private wastewater pump station (WWPS) and private non-standard sewer service that discharges to an existing HWC maintenance structure, H3216. From the connection at H3216 the wastewater gravitates within the HWC network to a HWC owned wastewater pump station (Nulkaba 1 WWPS). Hunter Water have advised that Nulkaba 1 WWPS has limited pump capacity and emergency storage.

The existing private WWPS has been designed to cater for a larger population than currently on site, but not the ultimate school population proposed as part of this SSDA. The population on site is less than the ultimate design capacity of the system and therefore a self dosing mechanism currently pumps clean 5kL water per day into the network to manage septicity and odour issues that would otherwise occur due to low flows. The proposed strategy is to reduce the clean water flows into the system to offset increases due to the increase in population as the school grows. If the measured flows from the development approach the limit of the network, system upgrades may be required, in collaboration with Hunter Water Corporation.

HWC has provided two options for upgrade if the capacity of the network was to be exceeded:

- Option 1: Ensure the private WWPS does not exceed the current discharge flow rates and thus operates within the network constraints. This may include providing additional storage within the site. We have been advised by Hunter Water this option may still require upgrades of the emergency storage at Nulkaba 1 WWPS.
- Option 2: Deliver necessary upgrades to HWC infrastructure and discharge at the peak design flow rate (this would need further review however often includes items such as changing pumps and associated electrical upgrades, increasing emergency storage at the pump station and occasionally making changes to the sewer rising mains).

It is understood that the existing sewer system was sized for a population of approximately 1,720 staff and students. It has been projected that there will be a total of approximately 1,732 staff and students in the school in 2029 and up to 1,948 staff and students from 2033 onwards.

This strategy is subject to further consultation with HWC during detailed design and application for a Section 50.

7. Conclusion

The proposed preliminary engineering design presented above and depicted on the civil drawings has been prepared to support a State Significant Development Application (SSDA) submission to the NSW Department of Planning, Industry and Environment. This report is to be read in conjunction with the complete SSDA package which covers elements of the SEARs not addressed within this report.

The design has considered the SEARs Council's DCP, Australian Standards, and industry best practice and found the proposed development can adequately meet the legislative requirements and is considered appropriate for the intended development and use. In summary, the following elements have been addressed.

7.1. Site Grading and Bulk Earthworks

The Civil drawings and report provide details of earthworks and grading across the site and how these are kept clear of Aboriginal Heritage PADs. The proposed filling extents have been designed in collaboration with the Flooding Assessment undertaken by BMT.

7.2. Erosion & Sediment Control (SEARs Item 18. Soil and Water)

The report includes an assessment of potential impacts on surface water, soil, related infrastructure and watercourses and provides details of how these can be mitigated. The Civil drawings and report provide details of site grading and bulk earthworks concept Erosion and Sediment Control measures to be implemented before during and after construction.

7.3. Stormwater Management Strategy (SEARs Item 16. Stormwater Drainage)

The Civil drawings and report provide details of the proposed stormwater management plan, including details of on site retention (in lieu of detention), water quality measures and the nominated points of discharge to Black Creek. All stormwater detailed in this proposal is within the site and therefore to be maintained by the School and not Council.

7.4. Sewer and Water Servicing (SEARs Item 15. Utilities)

Consultation with the sewer and water service authority, Hunter Water Corporation, has been undertaken and determined that the proposed School upgrade can be accommodated by the existing water network. Similarly, the existing internal WWPS has been sized for a larger capacity than currently exists on site and can accommodate an increase in student numbers. Some upgrades to the existing sewer network may be required to accommodate the final student numbers, however this will be determined during detailed design phase in collaboration with Hunter Water Corporation.

We note the information contained in this report is not intended to present detailed design solutions but rather provide solutions commensurate with a conceptual design suitable for SSDA assessment.

Based on our investigations and preliminary designs, the proposed development can adequately manage and address site grading, erosion and sediment controls, stormwater management, and sewer and water servicing; and we commend our findings to NSW DPIE for assessment. Should you have any queries, please feel free to contact the undersigned on (02) 4943 1777.

Yours faithfully,

Gemma Wood
Civil | Environmental Engineer
BEng (Environmental) (Hons)

Appendix A – Masterplan

For Approval

1. Dimensions are in millimetres unless otherwise shown.
2. Work to given dimensions. Do not scale from drawing.
3. Check all dimensions on site prior to construction and fabrication.
4. Bring any discrepancies to the attention of the proprietor & architect.

LEGEND

- Existing building
- Proposed buildings for SSD application

A - Junior School (Stages 1, 3 & 4)
B - Middle School (Stages 1 & 2)
C - Senior School + Library (Stage 1, 2, 3, 4)
D - Admin & Welcome Centre
E - Trade Training Centre (Stages 1 & 2)
F - Canteen / Cafe Hub
G - Performing Arts Centre
H - Sports Hall (Stages 1, 2 & 3)
I - Outdoor Meeting Circle
J - Narnia
K - Cafe
L - Boardwalks
M - Sports Field & Running Track
N - D.A.L.E (Stages 1 & 2)
O - Aquatic Centre
P - Existing Sports Fields
S - Waste Management Depot
Q - Existing Sheds
R - Existing House

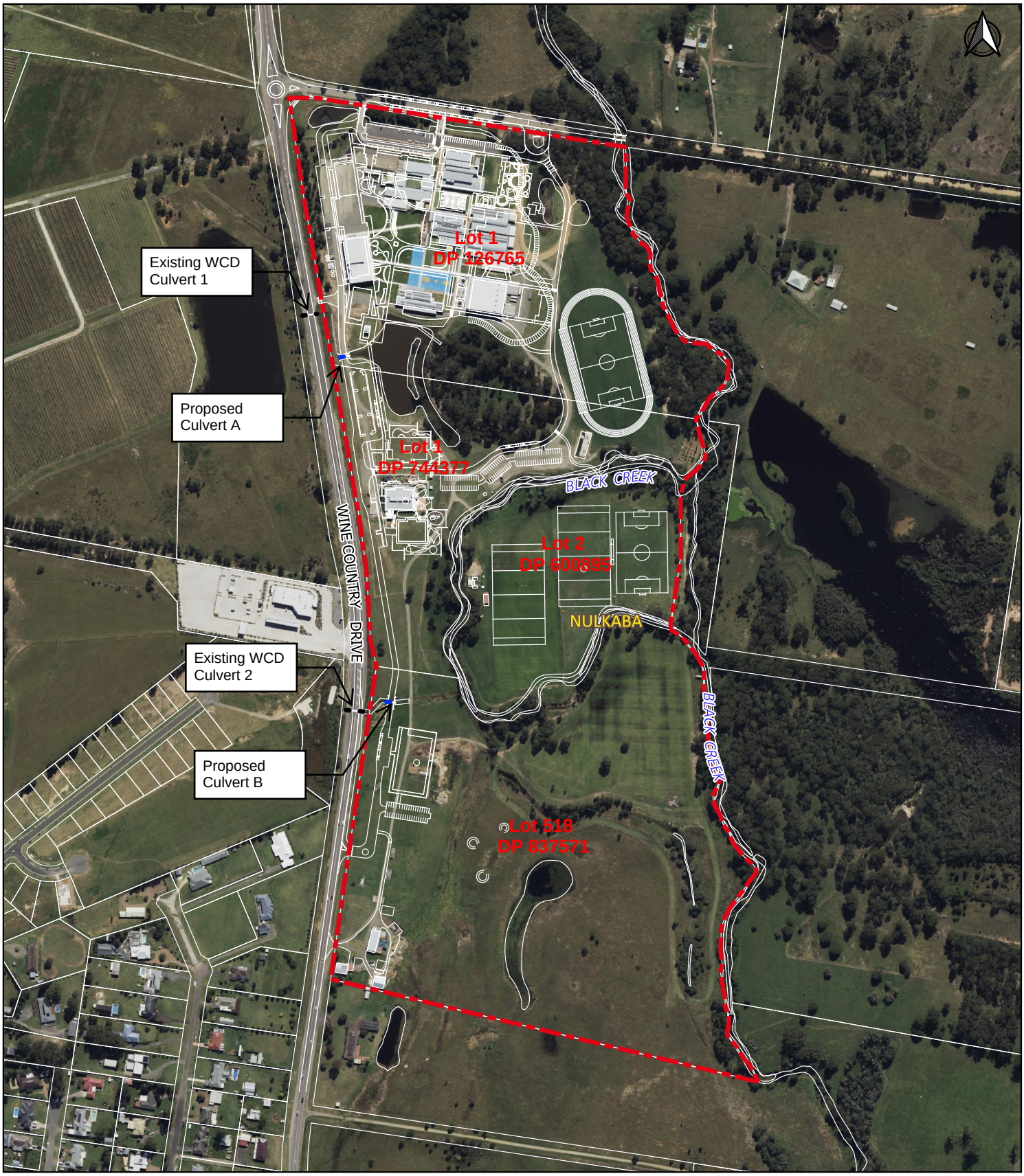
4347
SSD3004
Revl 23.11.21

Proposed Site Plan - Overall
St Philip's Christian College Cessnock
10 Lomas Lane, Nulkaba

0m 50 100 150 200 250 1:5000 @A3

SHAC
Nominated Architect Justin Hamilton (6160) | ABN 32 131 584 846

Appendix B – Culvert Assessment Figures



Legend

- Subject Site
- Existing Culverts
- Proposed Culverts
- Site Plan

0 100 200 300 Metres

1:6,000

Figure1

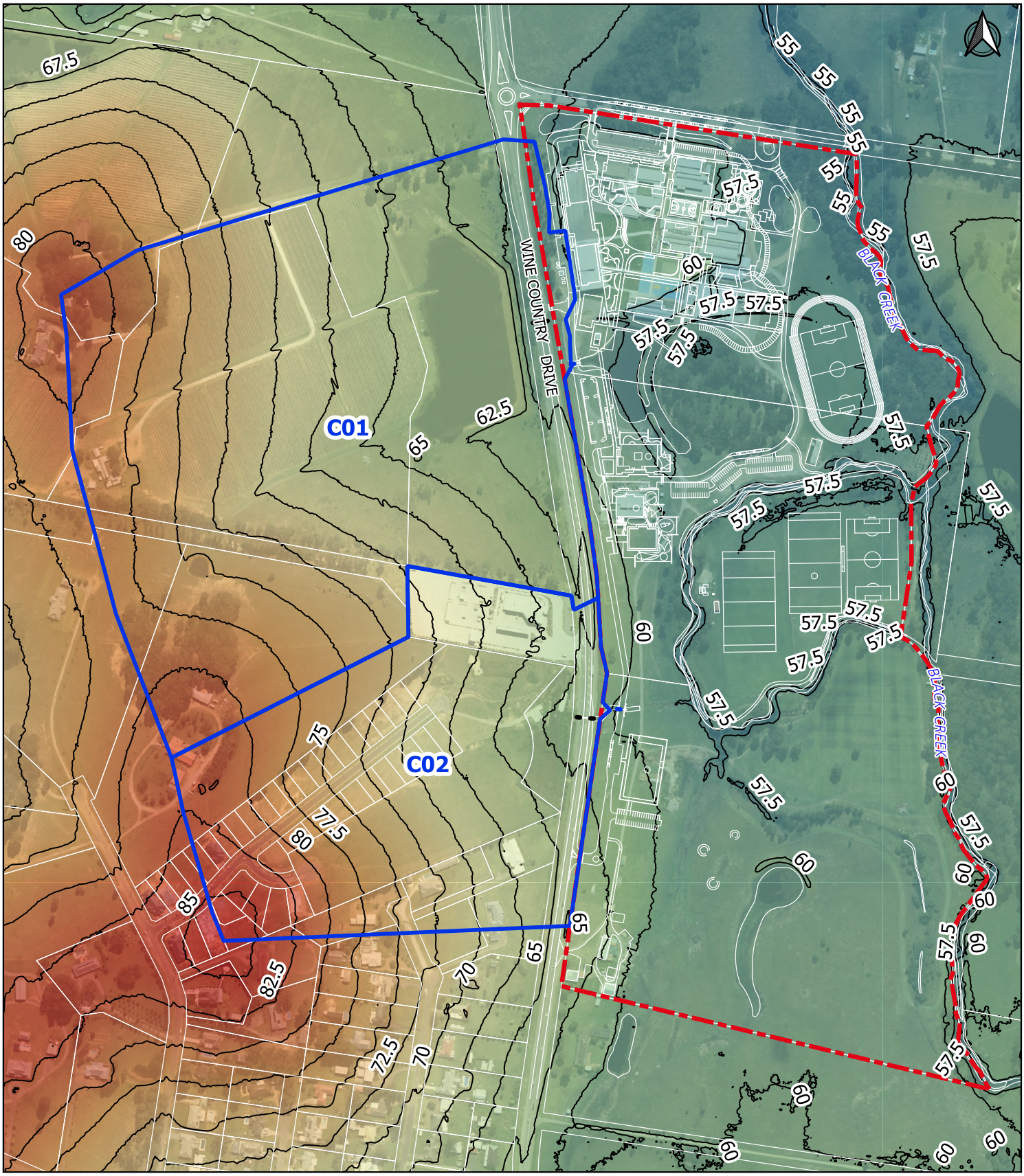
Subject Site Extent

St Phillip's Christian College
Nulkaba, NSW

NORTHROP

Data Source: LPI Cadastre

3/12/2021 Y:\YEAR 2016 Jobs\NL167397\O - Drawings\MAP\Figures\211203\QGIS Project.qgzQGIS Project.qgz



Legend

- Subject Site
- Existing Culverts
- Proposed Culverts
- Site Plan
- Contours (2.5m)

Terrain (LiDAR - mAHD)

86
53

0 100 200 300 Metres

1:6,000

Figure 2

Catchments and Terrain

St Phillip's Christian College
Nulkaba, NSW

NORTHROP

Data Source: LPI Cadastre

3/12/2021 Y:\YEAR 2016 Jobs\NL167397\O - Drawings\MAP\Figures\211203\QGIS Project.qgzQGIS Project.qgz

Appendix C – HWC Preliminary Advice

Hunter Water Corporation
ABN 46 228 513 446

PO Box 5171
HRMC NSW 2310
36 Honeysuckle Drive
NEWCASTLE NSW 2300
1300 657 657
enquiries@hunterwater.com.au
hunterwater.com.au

08 Nov 2021

ST PHILLIP'S CHRISTIAN EDUCATION FOUNDATION LIMITED
C/- Northrop Consulting Engineers
215-217 PACIFIC HWY
CHARLESTOWN NSW 2290

PRELIMINARY SERVICING ADVICE APPLICATION

Property Address:	10 LOMAS LANE, NULKABA NSW 2325
Lot & Plan number:	Lot 1 DP 126765
Development Description:	Preliminary Servicing Application for Expansion of St Phillip's Christian College; Development of Aquatic and Sports Facilities
Hunter Water Reference:	2021-1481

General information on water and sewer issues relevant to the proposal are included in this correspondence. This information is indicative only and based on Hunter Water's knowledge of its system performance and other potential developments in the area at the present time. This advice may change substantially due to a range of factors and a detailed analysis of available capacity will be undertaken upon lodgement of a Development Application to Hunter Water.

When you have development approval, you may submit this Development Application to determine the formal requirements for the development. Hunter Water will then issue a Requirements Letter including an offer for network capacity.

Hunter Water offers the following preliminary servicing advice for the provision of water and sewerage facilities for the development detailed above.

Water Supply

There is sufficient capacity in the water network to service the proposed development.

The existing College is serviced by a 150mm private water service a directly connected to the 300mm DICL watermain in Wine Country Drive. Your hydraulic design consultant will need to confirm this existing connection is suitable to service the staged increase in development demands.

Given the existing and future development is serviced by a single watermain, then a failure of this watermain or your service pipeline will impact the operations of the College. Whilst Hunter Water would make ever endeavour to provide an alternative supply, you may wish to consider installing an alternative water supply, such as a storage tank and pump system, on the College site.

Wastewater Transportation

The existing College is serviced by a private wastewater pumping station (WWPS) with an 80mm PE rising main which discharges into Manhole H3216 in the Nulkaba 1 WWPS catchment.

Nulkaba 1 WWPS has limited pump capacity and emergency storage to service the incremental increase in development loads from the proposed development.

There are two options available to service the development:

- Design and construct a private pump to sewer system which will operate within the network constraints; or
- Deliver the necessary upgrades to Hunter Water's network.

To determine the preferred option, you will need to engage an Accredited Design Consultant to prepare a sewer servicing report for your development.

For guidance on the network constraints, we refer you to the Waste Water Servicing Report (Rev: B; 05/06/2018) prepared by Northrop for the St Emelion Holdings development in Nulkaba.

Your design consultant should request an inception meeting with Hunter Water prior to preparing the report.

Wastewater Treatment

Nulkaba 1 WWPS discharges directly to Cessnock Wastewater Treatment Works, and any increase in pressure and flows in the rising main will need to be assessed in the sewer servicing report.

Delivery of Developer Works

Developer works will need to be delivered under Developer Works Deeds executed by the Developer and Hunter Water.

All developer works are to be designed by an Accredited Design Consultant and constructed by an Accredited Contractor.

Environmental Requirements

Hunter Water may require a Review of Environmental Factors (REF) to be submitted in accordance with the provisions of Environmental Planning and Assessment Act 1979 for the delivery of developer works. Hunter Water will assess the REF as a determining authority under provisions of Part 5 of the Act.

Entry Requirements

The proposed investigation works may require entry to another property. You will need to arrange for entry and have evidence of consent by way of a signed Entry Permit with the affected landowner.

These preliminary requirements are not commitments by Hunter Water and maybe subject to significant change prior to this development proceeding.

If you have any enquiries, please contact your designated assessment officer below.

Barry Calderwood
T: 02 4979 9721
E: barry.calderwood@hunterwater.com.au

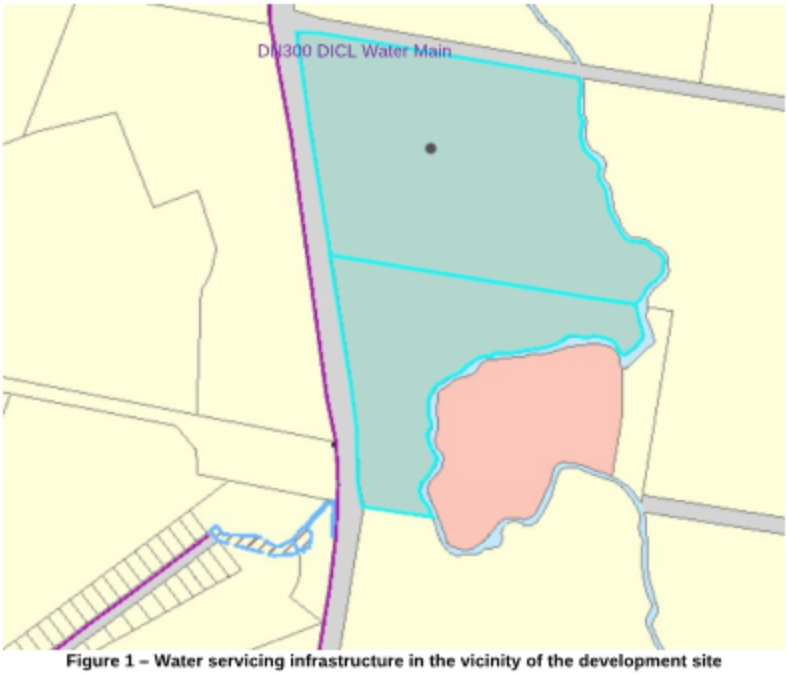


Figure 1 – Water servicing infrastructure in the vicinity of the development site

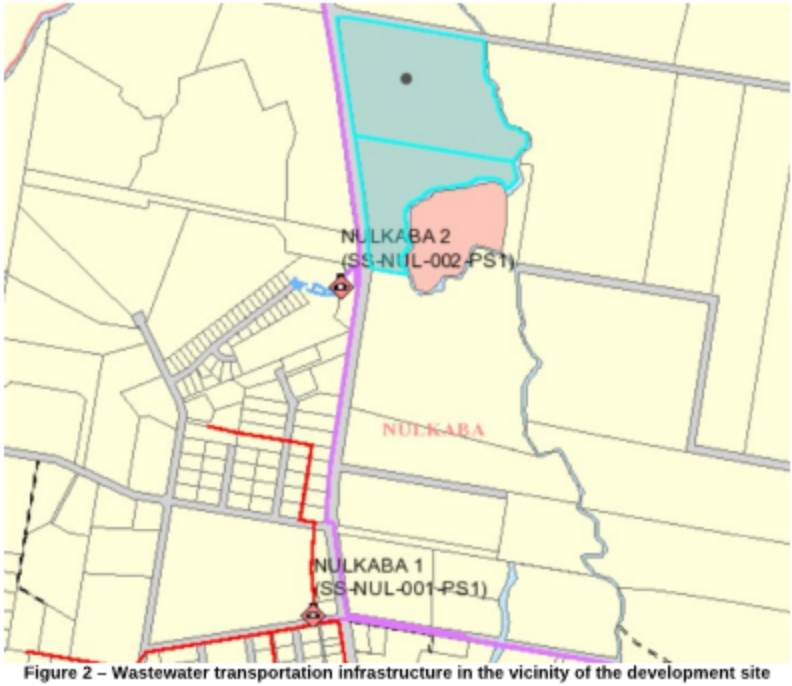


Figure 2 – Wastewater transportation infrastructure in the vicinity of the development site

Appendix D – Civil Drawings

Provided separately due to size