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ST MATTHEWS CATHOLIC SCHOOL
BROADHEAD RAOD, MUDGEE

CIVIL AND STORMWATER REPORT

15 SEPTEMBER 2020

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1 INTRODUCTION AND PROJECT DESCRIPTION

Triaxial have been engaged by TSA Project Management to undertake the civil and stormwater design of the proposed Catholic School located at Lot 40, Broadhead Road, Mudgee.

The SSD DA seeks consent for the construction of a new multi-purpose secondary education facility within the Mudgee Region that meets future demands for the developing region.

The new secondary school to be known as St Matthews Catholic High School Mudgee School will cater for 680 secondary school students (4-Stream Year 7-12) and will comprise of a cluster of five low-rise school buildings (1-2 storeys) including;

- Block A - Professional Hub (office and administration)
- Block B - Spiritual Hub (Chapel)
- Block C - Community Hub (Multi-purpose hall, Music/Dance Studio, and canteen)
- Block D – STEM Research Hub (teaching spaces)
- Block E - Knowledge and Learning Hubs (General Teaching spaces)
- Yarning Circle (Outdoor learning area)
- Outdoor Student Assembly Area and COLA
- Student free play area
- Staff and student amenities
- Associated site landscaping and public domain improvements
- On-site parking and access arrangements off Bruce Road, including:
    - On-grade car park for staff, students, and visitors (75 spaces – including 2 accessible spaces)
    - A 12-bay student drop-off and pick-up area
    - A 3-bay bus drop-off and layover area
    - Bus turning area and servicing access
    - Dedicated separate driveway for service vehicles
    - Bicycle parking for 30 bicycles
- Associated earthworks, civil works, perimeter roadworks, fencing, services and utilities connections and augmentation, including:
    - Roadworks to Broadhead Road and Bruce Road to the full extent of the site frontages
    - Roadworks to the Broadhead Road and Bruce Road intersection to cater for bus movements
    - Footpath along the site frontage of Broadhead Road and suitable pedestrian crossing to connect to existing footpath.
    - Stormwater infrastructure upgrades adjacent to and within the site, including new culverts and drains, levee, and bioswale.
    - Connection to existing sewer line within the site
    - Electrical and water connections into the site

Figure 1: Existing Site

2 EXISTING SITE CONDITIONS

2.1 DEVELOPMENT SITE

The site is proposed to be developed as a secondary school, in line with the preliminary architectural plans provided.

The proposed development site is located at the intersection of Bruce Road and Broadhead Road in Mudgee as shown in Figure 1.

Bruce Road is unsealed along the frontage of the site. Broadhead Road is sealed with a narrow pavement of 6m width constructed from the Northern side of the site. Towards the Southern end of the site Broadhead Road has been recently upgraded to a 7m wide sealed road with table drains either side.

A large 3 cell culvert has been constructed under Broadhead Road, consisting of 3 x 2.4m wide by 0.9m high culvert cells to allow the passage of stormwater. Bruce Road has 2 x 900mm stormwater culverts currently allowing stormwater to cross the Western side of the Broadhead

Road intersection where it continues to flow towards the new 3-cell culvert under Broadhead Road.

Refer Appendix A – Triaxial Plan TX13843.00-C2.0

A large diameter water main runs along the Northern side of Bruce Road where it crosses the intersection with Broadhead Road before continuing Southwards along the Eastern side of Broadhead Road.

A large diameter sewer main runs through Lot 40 DP 756894 (the proposed school site) along the alignment of the riparian corridor. The sewer main is a 225mm diameter sewer line with capacity to convey sewer from the proposed school and upstream developed catchment.

2.2 STORMWATER CATCHMENT

The proposed site sits within a large natural catchment that is noted as “Sawpit Gully” on extends well into Avisford Nature Reserve to the South and West of Mudgee township.

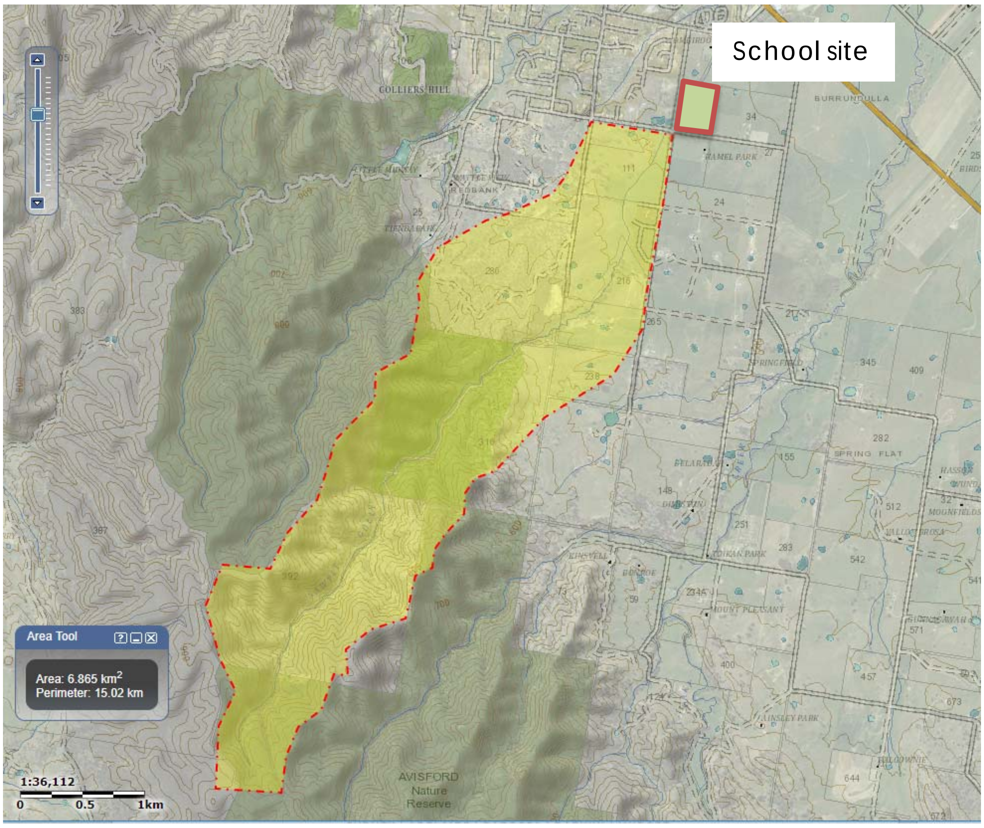

Figure 2: Catchment draining through proposed school site.

The total size of the catchment at the school site was measured as 686Ha. The length of the catchment from top to bottom was calculated at 6.7km.

The catchment is separated into two sub-catchments which combine near the intersection of Bruce and Broadhead Road.

At the upper end of the catchment the flow is contained in well defined channels and creek beds, however when the channel descends into the lower part of the catchment it spreads to become overland sheet flow, especially after the flow crosses Plenty Road, 600m upstream from the School site. At the school site the stormwater from the catchment flows through the existing twin 900mm diameter culverts under Bruce Road and through the larger culverts on Broadhead Road before heading North East towards the Castlereagh Highway.

The existing culverts under Bruce Road have capacity to take the minor flows up to the 2-year event, but anything above these flow rates will be inundated.

Flow rates generated from the study of the upstream catchment are listed below:

	100yr Event	20yr Event	5yr Event
Inflow 1 – Flow Rate (m^3/s)	41.1	23.5	8.75
Inflow 2 – Flow Rate (m^3/s)	8.1	5.2	2.6

Table 1: Flow rates used at the School site based on catchment analysis.

The flow rates generated in the modelling were obtained using a RAFTS model with the following characteristics:

- Initial loss = 25mm/hr
- Continuing loss = 2.5mm/hr
- Catchment fraction impervious = 15% for rural areas, 0% for natural undisturbed areas (heavily vegetated).

These parameters are in line with previous catchment studies completed within the Mudgee region.

The school site has an existing legal point of discharge for this stormwater catchment by the existence of a 70m wide easement to drain stormwater that exists over the downstream block to the North of the School site, Lot 4 DP1164833. It is anticipated that no changes to the existing flow conditions within this easement will be introduced by the development of the school site.

3 PROPOSED SITE REQUIREMENTS

3.1 ROAD UPGRADES – SURROUNDING ROAD NETWORK

It is proposed to upgrade the surrounding road network in accordance with Triaxial plans TX13843.00-C1.0 through C7.0. Upgrades to the existing road network are proposed to be in accordance with the rural position of the school, including table drains in lieu of kerb and guttering.

Refer Appendix A – Triaxial Plan TX13843.00-C3.0

A summary of the proposed surrounding road upgrades is listed below:

- Upgrade Bruce Road for the full frontage of the site. Full road construction, minimum 7m wide pavement with table drains either side.
- Upgrade Broadhead Road for the full frontage of the site. Full road construction, minimum 7m wide pavement with table drains either side.

3.2 FLOOD MITIGATION WORKS

Information from Mid Western Regional Council indicated that a large proportion of the upstream catchment flows through the school site in a broad sheet flow rather than being contained in existing stormwater channels.

In order to determine the effectiveness of the flood mitigation measures and to determine the effect of these on the downstream flow, a TUFLOW model was developed.

TUFLOW was adopted due to the need to model the flow in two dimensions and fully capture the sheet flow that the catchment experiences during a major storm event.

The TUFLOW model was developed using the following input:

- Catchment elevation data from ELVIS website (ANZLIC Committee on Surveying and Mapping). Mudgee region 1m LiDAR survey.
- Bing maps aerial imagery.
- School buildings positioned on site with finished floor levels as documented on the architectural plans.

The TULFOW model was then run using the following input:

- 1m elevation grid (to AHD).
- 1 second timestep. 4-hour model run time to capture the critical storm duration and development through the catchment.
- Downstream boundary condition was representative of the existing ground slope at the model boundary.
- Hydrographs were input for each of the inflow upper boundaries corresponding to the 1%AEP inflow hydrograph for the major catchment (Inflow 1) and the minor catchment (Inflow 2).

An image of the 1% AEP flood flow is shown below:

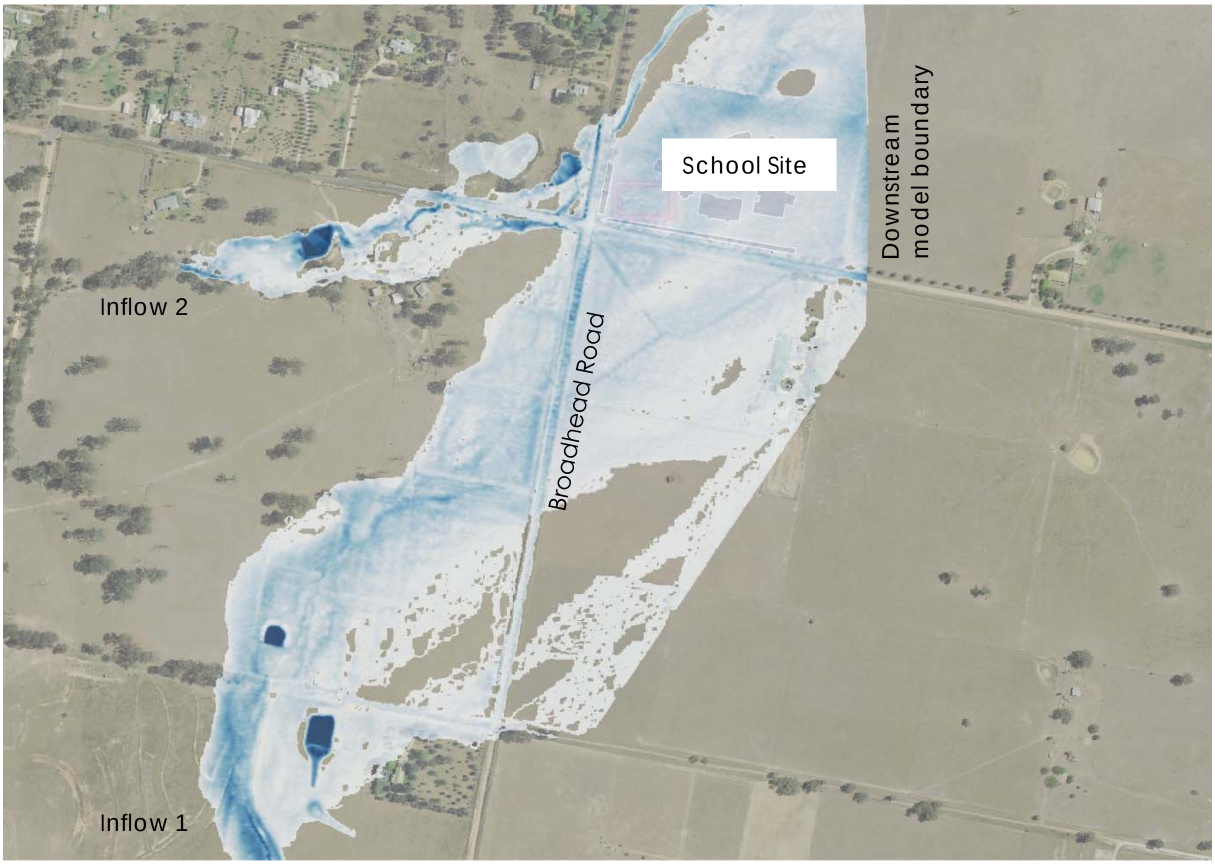

Figure 3: Catchment draining through proposed school site.

As can be seen the sheet flow inundates the proposed school site at depths of between 100mm – 300mm.

Proposed works to mitigate the effects of the large catchment draining through the site include:

- Upgrade to the existing culverts under Bruce Road to have sufficient capacity to allow flood waters under Bruce Road and Broadhead Road to pass through and around the site. Currently the flood waters are constricted by the existing culverts under Bruce Road. Upgrading these culverts will allow the passage of stormwater through the Bruce Road and Broadhead Road intersection along the North Western side of the school site.
- Construction of a minor (500mm) high bund running along the perimeter of the school frontage on Broadhead and Bruce Roads to divert low level sheet flow.
- Increase in the level of Broadhead road around the intersection with Bruce Road.
- Finished floor levels of the site buildings to be above the 100yr flood level.

These upgrades to existing stormwater infrastructure are shown on Triaxial plans along with the extent of the existing and future flooding.

Refer Appendix A – Triaxial Plan TX13843.00-C2.1

In order to determine the effectiveness of the proposed levee bank and culvert upgrades on the school site, the TUFLOW model was rerun with the following properties:

- Design surface input from Triaxial Consulting plans (CAD finished levels design).

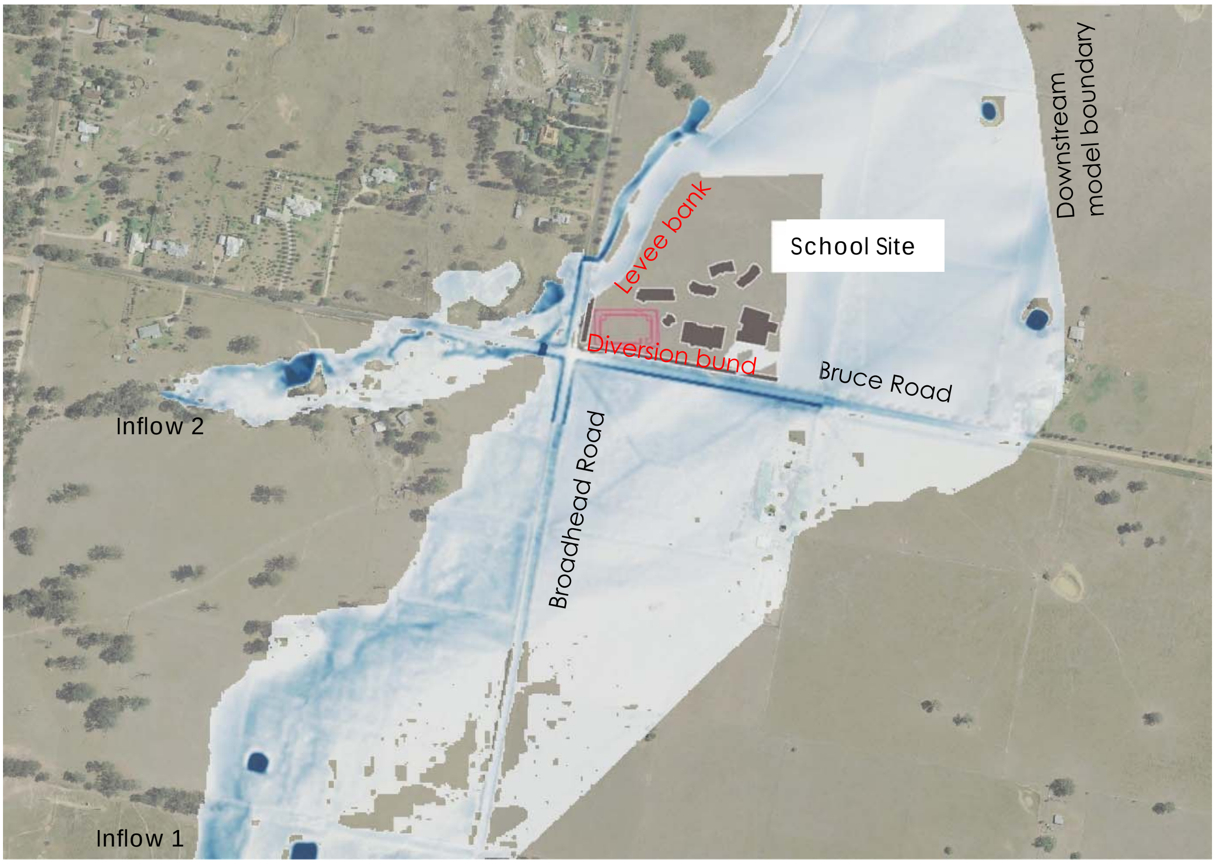

Figure 4: Post development site with levee bank protection along Broadhead and Bruce Road.

As can be seen from Figures 3 and 4 above, the flow through the site is protected by the new levee bank and diversion bund. The bund along Bruce Road was input as a minor landscaped bund approximately 500mm high. The levee bank along the riparian corridor was input as an 800mm – 1m high levee bank with 1:6 side slopes for ease of maintenance.

The results from the modelling indicate that the school site will not be affected during the 100yr event. The property immediately upstream on the Southern side of Bruce Road will experience a minor increase in flood depth, with some areas carrying water during the 100yr even that were not previously. The depth of water is minimal, with depths ranging from 1mm through to 15mm depth of flow.

To determine the impact on the neighbouring property to the East, a section was developed showing the pre and post (design) 1% AEP flood level at the boundary. The location of the section is shown in the image below:

Figure 5: Section taken along adjacent boundary to check flow depths and velocities (shown in red).

The pre and post flood depths along the section as shown in Figure 5 are shown on the image below:

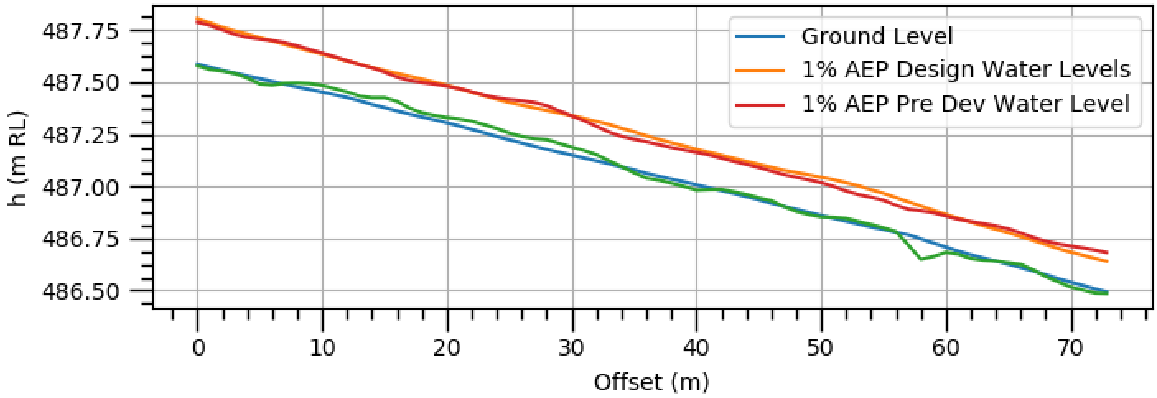

Figure 6: Section data along boundary showing minimal difference in 1% AEP flood depths

The pre and post flood velocities along the section as shown in Figure 5 are shown on the image below:

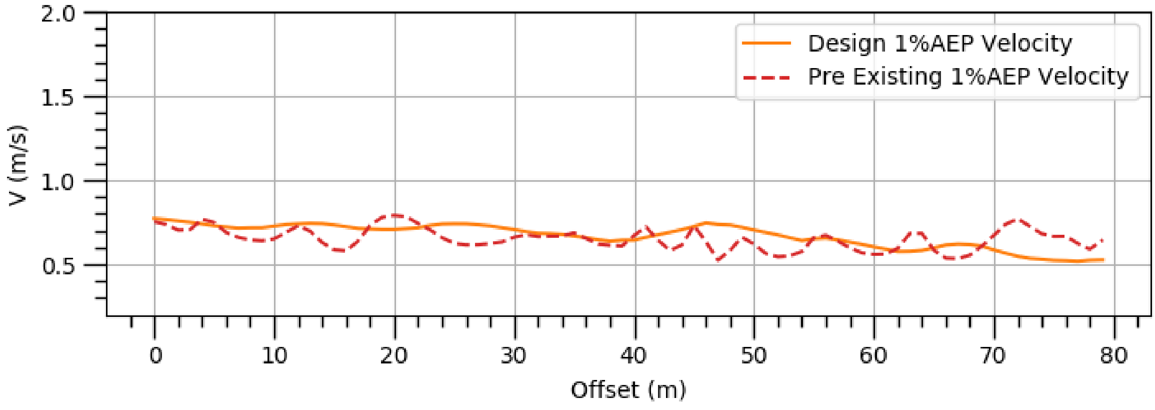

Figure 7: Section data along boundary showing minimal difference in 1% AEP flood velocities

The major conclusion from the modelling data is that the redirection of the water around the school site will cause no substantial increase in flood depth or velocity at the boundary of the neighbouring property. This appears to be due to the levee bank and reconstruction of Bruce Road directing more flood water along the road reserve than was previously conveyed in the undeveloped state.

3.3 INTERNAL SITE STORMWATER MANAGEMENT

Proposed works to allow the safe passage of stormwater through the site include the following measures in accordance with Mid Western Regional Council Development Control Plan guidelines:

3.3.1. Stormwater Modelling – DRAINS Model

A DRAINS model was developed for the internal site drainage. The DRAINS model included modelling nodes for each surface and roof catchment, as well as all downpipes, pits, and pipes throughout the site.

The hydrological model used in the modeling of the stormwater was an ILSAX type model with the following characteristics typical to the Mudgee area:

Paved area depression storage = 1mm

Supplementary area depression storage = 1mm

Grassed (pervious) area depression storage = 5mm

Soil type typically 2.5

Rainfall data was then input for a range of storms directly from the Australian Rainfall and Runoff module in the DRAINS program. Design storms included the 5, 20 and 100 yr ARI for durations of 5, 10, 20, 30, 60 and 90 minutes.

For the minor system drainage (piped drainage), the worst-case 5yr ARI storm was used as the design criteria to select the pipe sizes for the development.

Pit and pipe layout was input into the model and catchments were assigned to each pit based on the site contours. Fraction impervious for each of the catchment areas is as per the example given in Australian Rainfall and Runoff (AR&R, 1987) section 14.5:

Carparking, Roof areas or Roads = 100%

Soft Landscaped areas (grassed) = 5%

Existing pre-developed conditions = 5%

These percentages of impervious area are in line with the recommended values listed in Table 5.2 of the DRAINS software manual that were obtained from a study of 16 different gauged fully developed catchments in Victoria.

For catchments with combinations of these different land types were present (i.e. Landscaping areas combined with an area of roadway), an interpolated fraction impervious was calculated based on the area of land in each category.

Overflow routes were included in the model to ensure that the flow width of any overflow route in the minor storm would not exceed the allowable 2.5m gutter flow width.

ILSAX model results were checked in the DRAINS software by running an extended rational method model to check the results. The values obtained in the extended rational method model were within 5% of the values obtained using the ILSAX hydrological model.

For full details of the proposed stormwater network refer to Triaxial Consulting plans

Refer Appendix A – Triaxial Plans TX13843.00-C1.0

3.3.2. Stormwater Modelling – MUSIC Model

A MUSIC model was developed to ensure that the stormwater runoff from the site has been treated to ANZECC guidelines as outlined in Mid Western Regional Council DCP with specific pollution targets as follows:

- Reduction of Total Suspended Solids (TSS) of 85%
- Reduction of Phosphorus (P) of 65%
- Reduction of Nitrogen (N) of 45%
- Reduction of Gross Pollutants of 100%

A copy of the MUSIC model has been included with this report.

The treatment train for the MUSIC model includes having two bioretention basins, one at the outlet location to the North of the site adjacent to the riparian corridor, and the other within the carpark to treat the local carpark runoff before discharging the stormwater along Bruce Road.

A schematic of the MUSIC model is shown below:

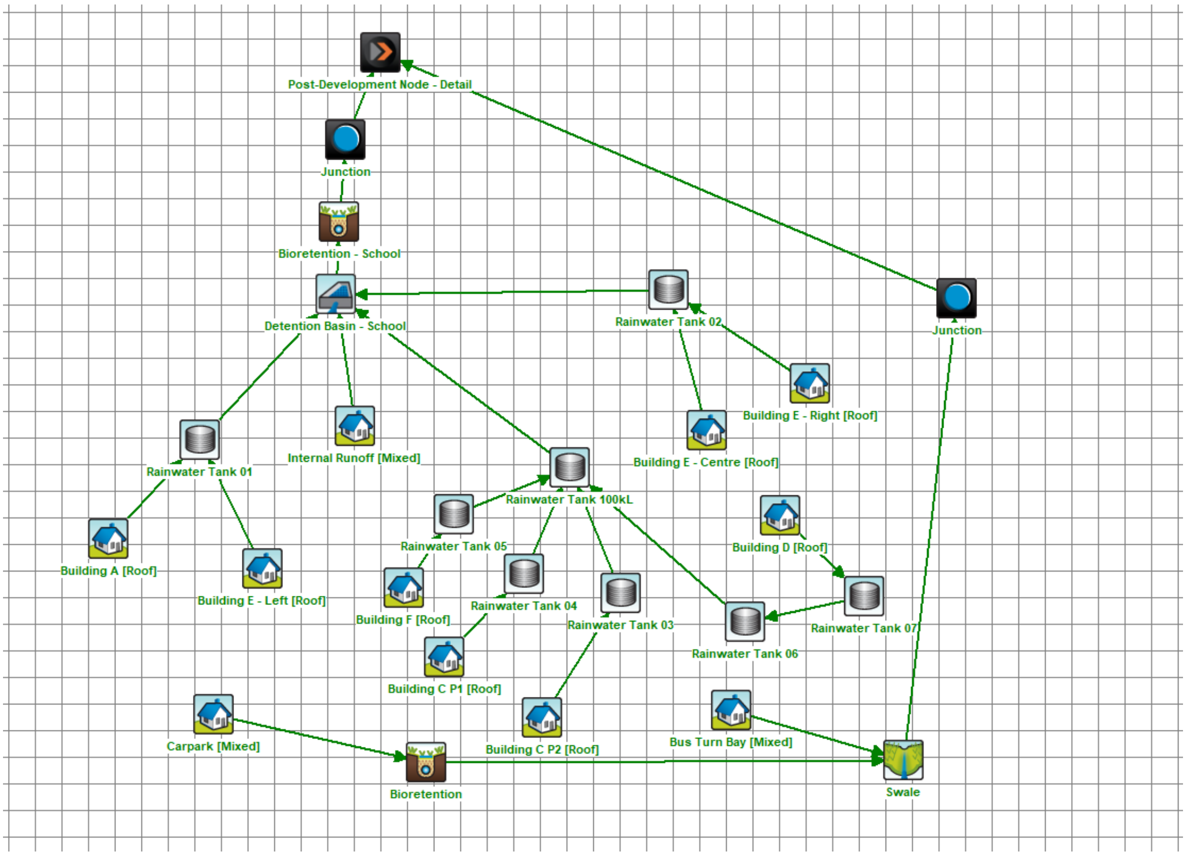

Figure 4: MUSIC model setup.

The results of the MUSIC model with the total site post-developed treatment methods modelled are as shown below:

Treatment Train Effectiveness - Post-Development Node - Detail

	Sources	Residual Load	% Reduction
Flow (ML/yr)	5.99	4.05	32.5
Total Suspended Solids (kg/yr)	768	105	86.3
Total Phosphorus (kg/yr)	1.8	0.594	67
Total Nitrogen (kg/yr)	15.4	7.73	49.9
Gross Pollutants (kg/yr)	205	0	100

Include Pre-Development

Figure 5: MUSIC model output

Pollution results from the modelling are all above the recommended reduction targets.

4 SUMMARY

In summary, the proposed upgrades to the surrounding road network along with the upgrades to the culverts under Bruce Road and the construction of a levee bank along the Broadhead and Bruce Road frontages of the site will provide safe passage for stormwater and protect the school buildings and infrastructure during a large storm event. As shown by the development of a pre and post development TUFLOW flood model, there will be minimal impact on surrounding properties due to the construction of the site and levee banks.

DRAINS and MUSIC models have been developed in accordance with Mid Western Regional Council requirements to allow sizing of stormwater network requirements and pollution reduction treatment methods, which are documented in Triaxial Consulting plans attached to this report.

APPENDIX A – TRIAXIAL PLANS TX13843.00-C1.0

APPENDIX B – DRAINS MODEL INFORMATION

SUB-CATCHMENT DETAILS

Name	**Pit or Node**	**Total Area** (ha)	**Paved Area** %	**Grass Area** %	**Supp Area** %	**Paved Time** (min)
Cat-BLDG-1E	BLDG-E-DP	0.07	100	0	0	5
Cat-BLDG-2B	BLDG-2B-DP	0.14	100	0	0	5
Cat-A2	A2	0.026	60	40	0	5
Cat-BLDG-Da	BLDG-D-DPa	0.1	100	0	0	5
Cat-A1	A1	0.02	50	50	0	5
Cat-C1	C1	0.032	100	0	0	5
Cat-Y1	Y1	0.017	100	0	0	5
Cat-X5	X5	0.065	100	0	0	5
Cat-Z2	Z2	0.047	100	0	0	5
Cat-X1	X1	0.16	20	80	0	5
Cat-W1	X2	0.189	90	10	0	5
Cat-Z1	Z1	0.0115	100	0	0	5
Cat-BLDG-Ca	BLDG-C-DPa	0.105	100	0	0	5
Cat-BLDG-F	F-DP	0.0309	100	0	0	5
Cat-BLDG-A	BLDG-A-DP	0.0948	100	0	0	5
Cat-BLDG-Cb	BLDG-C-DPb	0.105	100	0	0	5
Cat-BLDG-Db	BLDG-D-DPb	0.1	100	0	0	5

PIPE DETAILS

Name	**From**	**To**	**Length (m)**	**U/S IL (m)**	**D/S IL (m)**	**Slope (%)**	**Dia (mm)**
Pipe129	BLDG-E-DP	A3	8.496	487.453	487.368	1	225
PipeA3	A3	OSD	48.856	486.79	486	1.62	500
Pipe-ROOF-B2	BLDG-2B-DP	A2	44.092	494.379	487.313	16.03	225
PipeA2	A2	A3	30.918	486.945	486.79	0.5	375
Pipe-ROOF-D1	BLDG-D-DPa	O/3	24.556	494.453	488.453	24.43	225
PipeOP3	O/3	A1	47	488.28	488.045	0.5	375
PipeA1	A1	A2	44.809	488.015	487.167	1.89	375
PipeC1	C1	C2	50.148	487.353	487.102	0.5	225
PipeC2	C2	A3	30.99	487.072	486.917	0.5	375
PipeY1	Y1	X5	10.865	488.892	488.112	7.18	100
PipeX5	X5	Z2	37.13	487.778	487.592	0.5	375
PipeZ2	Z2	N158	72.989	487.592	487.197	0.54	450
PipeX1	X1	X2	10.296	488.963	488.673	2.82	225

PipeX4	X2	X5	25.217	488.611	487.911	2.78	300
PipeZ1	Z1	Z2	100.395	491.077	489.707	1.36	100
Pipe-ROOF-Ca	BLDG-C-DPa	O/1	15	494.453	488.453	40	225
PipeOP1	O/1	O/2	10	488.4	488.391	0.09	300
PipeOP2	O/2	O/3	16.3	488.391	488.31	0.5	300
Pipe-ROOF-F	F-DP	C2	25	494.392	487.922	25.88	100
Pipe-ROOF-A	BLDG-A-DP	C2	130.4	501.453	487.983	10.33	225
Pipe-ROOF-Cb	BLDG-C-DPb	O/2	15	494.453	488.453	40	225
Pipe-ROOF-Db	BLDG-D-DPb	A2	54.3	494.453	487.313	13.15	225

PIT / NODE DETAILS

Name	Type	Size	Surface Elev (m)	Max Pond Depth (m)	x	y
BLDG-E-DP	OnGrade	Downpipe	488		743787.7	6387764
A3	OnGrade	Junction Pit or Manhole	488.37		743783.6	6387772
BLDG-2B-DP	OnGrade	DP2	495		743861.7	6387787
A2	Sag	900 x 900	487.86	0.2	743831.3	6387756
BLDG-D-DPa	OnGrade	Downpipe	495		743874.1	6387681
O/3	OnGrade	Junction Pit or Manhole	489		743830.3	6387687
A1	Sag	900 x 900	488.84	0.2	743832.4	6387721
C1	Sag	900 x 900	487.9	0.2	743798.9	6387737
C2	OnGrade	900 x 900	488.53		743775.5	6387742
Y1	OnGrade	SA1	489.5		743731.3	6387677
X5	Sag	SA1	488.72	0.15	743756.5	6387686
Z2	OnGrade	Single SO1 Pit	490.43		743767.7	6387651
N158	Node		489.2		743839.5	6387637
X1	OnGrade	SA1	489.71		743731.4	6387717
X2	Sag	900 x 900	489.42	0.2	743745.6	6387698
Z1	OnGrade	SA1	491.8		743669.1	6387669
BLDG-C-DPa	OnGrade	DP2	495		743781.6	6387684
O/1	OnGrade	Junction Pit or Manhole	489		743783.3	6387677
O/2	OnGrade	Junction Pit or Manhole	489		743826.8	6387670
F-DP	OnGrade	Downpipe	495		743762.3	6387714
N198	Node				743805.1	6387864
N331	Node		488		743918.4	6387652
BLDG-A-DP	OnGrade	DP2	502		743739.5	6387745
BLDG-C-DPb	OnGrade	DP2	495		743815.8	6387678
BLDG-D-DPb	OnGrade	Downpipe	495		743886.3	6387722