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Hassell
Level 2
88 Cumberland Street
Sydney, NSW, 2000

Tuesday, 6 December 2005

Attention: Penny Allan

Dear Penny

FORMER COAL LOADER SITE, WAVERTON DA WATER MANAGEMENT CONCEPT

As requested, following is our DA concept report for the parkland redevelopment of the former coal loader site at Waverton.

In the report, details of the proposed water management measures to be incorporated as part of the redevelopment are provided. The report has been prepared based on the principles of water sensitive urban design and ecologically sustainable development, to ensure the impact on ecological and social values is minimised and to produce an outcome which demonstrates that North Sydney Council is "*leading by example*" in the field of water management.

The Waverton Peninsula Strategic Masterplan (*Clouston 1999*), has been utilised as the guiding document for preparation of the report, with analysis of the following aspects of water management undertaken

- water cycle management;
- water quality management; and
- stormwater quantity management.

1. BACKGROUND

A study team headed by Hassell has been engaged to progress the redevelopment of the former coal loader site for future public parkland use. Patterson Britton & Partners (*PBP*) have been included in the team to provide specialist advice and investigate future stormwater management and drainage solutions.



Principals

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This latest consultancy builds upon earlier work undertaken by others, including the Waverton Peninsula Strategic Masterplan (*Clouston 1999*).

A major theme of the project is incorporation of sustainability principles throughout all applications on the site.

The site is a former industrial site, which was used for coal handling from 1920 to 1992. Today it contains a number of important features including items of industrial heritage, remnant bushland and general open space.

2. EXISTING DRAINAGE

A detailed inspection was undertaken on the 11 November 2005 to ascertain the existing drainage systems and associated catchments of the site. In broad terms the site can be broken into three main areas as follows (*refer to Figure 1*):

- The coal loader platform and tunnels beneath;
- The coal loader wharf; and
- The coal loader administration building precinct.

The coal loader platform consists of a concrete slab over a sandstone structure/tunnel system below. Openings exist within the slab that are connected to the tunnels below, however these openings have subsequently been blocked. Fill has also been spread across the surface of the platform, hence it was difficult to determine if any existing drainage features were present. Cut off drains exist along the eastern edge of the platform to intercept runoff generated by the small but steep upstream catchment located between the platform and Balls Head Drive (*0.18ha*). Other than this steep area, the catchment of the coal loader platform is generally limited to the platform itself (*0.84ha*). Small channels cast into the surface of the concrete walkway along the western edge of the platform were also observed. These drain vertically to the harbour below.

Beneath the platform are a series of tunnels that contain small drainage channels on either side of a central floor slab. These channels run into open channels outside each end of the tunnels and eventually discharge into the harbour. Today water that is captured by these channels would generally be limited to intercepted groundwater/seepage, however when the tunnel shafts were open and the coal loader was operational both water from the platform above and generated by coal suppression would have been collected and conveyed by these channels.

The coal loader wharf could not be inspected closely, however due to its permeable timber construction it appeared as though no formal drainage structures existed.

The coal loader administration building precinct consists of a series of brick buildings surrounded by sealed surfaces. Roof runoff is collected by some of the buildings and piped directly to a nearby wetland which has recently been constructed within a former oil tank footprint. The remaining buildings discharge their roof runoff directly onto the ground and this along with the surrounding surface runoff, sheets overland to Balls Head Bay. The total area of roof present in this precinct was calculated to be approximately 857m².

It appears that a septic tank exists on the site, located downstream of the buildings to the south of the wetland. Due to its proximity and elevation, it is suspected that effluent from this system may feed into the wetland. We assume that all sanitary services on site are currently connected to this septic tank.

The existing catchment draining to the constructed wetland is small (*ie not more than 1200m²*), although the majority of this catchment is impervious. Other sources of water that may feed this wetland include the effluent discharged from the septic tank on site and groundwater/seepage as the wetland is located at the base of a rock cutting. Based on the above, it is expected that the water level within the wetland would fluctuate markedly. Although, the shade provided by the established vegetation and the close cliff face would assist in reducing the evaporation rates.

An asphalt covered carpark area exists at the northern end of the administration building precinct. No formal drainage facilities exist in this carpark area with runoff generally sheeting across the carpark and running overland to Balls Head Bay.

The remaining grassed and landscaped areas within the administration building precinct also contain no formal drainage facilities and drain naturally in a manner similar to the above.

3. WATER BALANCE AND REUSE

Consideration of the opportunity to capture and reuse roof water, stormwater runoff, groundwater and even grey and black water generated by the site was undertaken as part of our investigation.

Collection of roof runoff for reuse provides a good opportunity on this site as ample roof area is available, the quality of roof runoff is generally good and the elevation of the roofs onsite allow drainage via gravity to storage systems without the need for pumps.

Another critical consideration is the quantity of end uses that are available on site for any water that is collected. Without expensive treatment systems, NSW Health support reuse of roof water for non potable purposes only (*ie toilet flushing, irrigation, car washing, laundry washing machine use*). Due to the non habitable use identified for this site (*ie day visitors and office space*) the reuse opportunity available is generally limited to toilet flushing and irrigation. Based on the small area of garden allocated for irrigation and the estimated average number of visitors to the site, the magnitude of this reuse opportunity is considered low to moderate only.

A large catchment on site that could also be utilised for capture of rainfall is the coal loader platform itself. In fact, it has been suggested that part of this catchment along with storage in the most eastern tunnel has been utilised in the past to provide a source of water for dust suppression. Reuse of a shallow depth of water on the surface of the coal loader platform for special functions/events has been raised as an occasional but potential end use opportunity for captured runoff.

The major issue to overcome if this option were to be implemented is the quality of water, its suitability for reuse in an untreated state and the cost of any treatment to bring it up to a suitable standard for human contact. Other issues include the lack of a high daily demand end use on the site (*ie if the water was not to be reused in large quantities for one off special*

events), mosquito risk and drowning hazard if storage was to be implemented in the tunnel with which people had access to.

In the event that the coal loader platform was to be inundated by a small depth of water in special events (say 100mm), then based on the platform surface area a total water volume of approximately 837m³ would be required. This could easily be stored within one of the tunnels up to a depth of approximately 1.8m (note that a use of a flexible bladder has been raised as one method of storing water within the tunnels). A system that allowed the entire coal loader platform surface to drain to this eastern most tunnel would be required, in addition to some method of blocking off this drainage when ponding on the surface was required for events. Other requirements likely to be needed would be treatment of the stored tunnel water to a level suitable for secondary human contact (probably UV disinfection or chlorination) and a pump system to get the stored water up to the surface. Assuming an annual average rainfall of 1,100mm and a volumetric runoff coefficient of 0.85, approximately 7,826m³ of runoff could be generated by the platform in an average year. Hence, ample runoff volume would be available to provide water for several events per year.

The other potential sources of water on site that could be utilised for reuse include groundwater, grey water and black water. Due to the site being on a peninsular and its rocky substrate, groundwater extraction opportunities would be limited. Based on the sites proposed parkland use (ie non habitable), generation of grey water would be limited (ie grey water is mainly produced from habitable uses such as laundry, shower, kitchen). Black water is made up of the wastewater generated by toilets, urinals and bidets. It is highly contaminated by human excrement and requires a detailed treatment process prior to any reuse. Black water would be available on this site (ie from toilets) and could be re used for both toilet flushing and irrigation but would require substantial capital investment for the treatment process equipment.

To ascertain the likely reliability of a reuse system supplied by roof runoff and being used to flush toilets and irrigate a small component of the site, a water balance assessment was undertaken using an inhouse programme developed by PBP.

3.1 PBP Water Balance Program

The PBP in-house water balance programme utilised in this assessment uses a dynamic analysis to represent the sites stormwater losses and gains over an historical rainfall period. The programme is a daily rainfall model, which accounts for all inputs and outputs within a closed system.

Inputs to the system include:

- rainfall; and
- potable water supply.

Outputs to the system include:

- interception;
- depression storage;
- soil moisture storage;
- infiltration;
- internal reuse;

- irrigation (*triggered only when it is determined to be required*) and
- evapotranspiration.

The water balance model offers the analysis of a combination of the following variable factors:

- impervious areas to rainwater tanks;
- impervious areas not to rainwater tanks;
- pervious areas to be irrigated;
- pervious areas not to be irrigated;
- forested areas;
- infiltration system areas (*ie bio-retention swales*); and
- wetland areas;
- rainwater collection tanks;
- internal reuse of collected rainwater; and
- irrigation of pervious areas with collected rainwater.

Refer to **Diagram 1** for a schematic of the PBP water balance model.

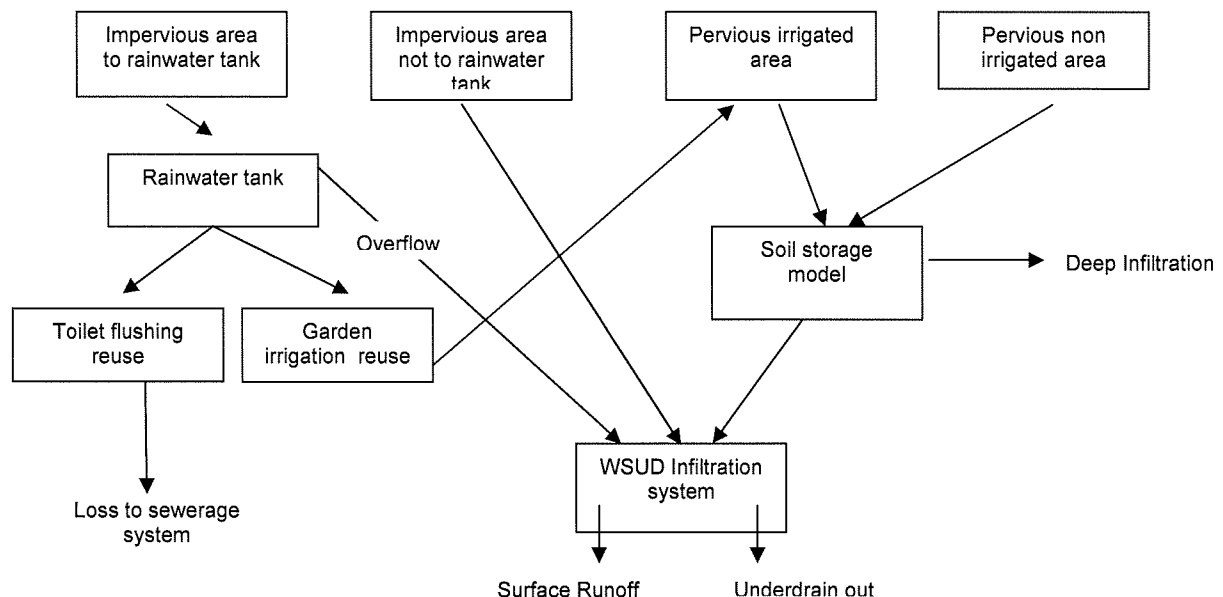


Diagram 1 – Water Balance Model Schematic

3.2 Model Inputs

Historical rainfall records over a four year period (*1995 to 1998 inclusive*) that contained a mix of dry, average and wet years was used.

For this analysis only the building precinct area that was to benefit from the roof runoff/rainwater re-use system was analysed. Runoff from Buildings A,B,C and D ($750m^2$) was assumed to run to a storage system (*ie rainwater tank*) for reuse. The impact of two different rainwater tank sizes was analysed (*50KL and 100KL*).

Reuse demand from the three main day to day uses envisaged on this component of the site (*ie office toilet use, visitor toilet use and garden irrigation*) was estimated based on our experience and some basic information provided by Council.

For the office, a total number of staff of 40 was used based on the 5 year projections from the current tenant. This equated to an average daily toilet flushing demand of 720L/day.

For visitor toilet use, two potential average daily demands were calculated. This was because the variability in potential visitors to the site could be high both within the week and over the year and as no detailed estimate of the expected numbers was available. For Scenario 1, it was assumed that the average daily number of visitors using the toilet on site was 200 and for Scenario 2 the number of visitors was estimated to be 100. At 200 visitors, the flushing demand would equate to approximately 1200L/day and at 100 visitors it would equate to 600L/day.

For this preliminary analysis, the garden irrigation rate was not determined by the model based on the soil storage module but set at a fixed rate of 280L/day (*ie based on our experience and a total area of 800m² of low demand garden/grass to be irrigated*).

The total reuse demand (*ie including all of the above uses*) was calculated to be 2.2KL/day for Scenario 1 and 1.6KL/day for Scenario 2.

3.3 Model Results

The model results showed that with both tank sizes there was a high reliability for the availability of rainwater for reuse.

For the 50KL tank connected to a reuse demand of 2.2KL/day (*ie Visitor Scenario 1*) a reliability of 74% could be achieved (*ie potable water top up was required only 26% of the time*). For comparison, this is a good result as the typical modern day dwelling based rainwater tank (*ie 2KL to 5KL tank*) linked to toilet flushing, garden irrigation, car washing and laundry use achieves around 40 to 50% reliability.

For the 50KL tank connected to a reuse demand of 1.62KL/day (*ie Visitor Scenario 2*) a reliability of 87% could be achieved. This is considered an excellent result compared with the traditional modern household.

For the 100KL tank connected to a reuse demand of 1.62KL/day (*ie Visitor Scenario 2*) a reliability of 98% could be achieved. This is also considered an excellent result compared with the traditional modern household but probably not cost efficient as you achieve an 11% increase in reliability with the added cost of a tank that is twice as big.

4. WATER QUALITY

In order to assist in the assessment of the current and future performance of the existing wetland that has been constructed on site within the administration building precinct, a MUSIC model has been created (*refer to **Appendix A1** for details*).

Note that other than for general litter generation, the annual pollutant loads that would result within the remaining landscaped areas of the site and on the timber wharf would not be

expected to alter dramatically compared with existing conditions and hence have not been modelled in MUSIC (*ie no substantial change in landuse compared with existing conditions*).

The coal loader platform is currently used as a construction depot site and is covered with un-stabilised fill material. Under proposed conditions it is expected to generate a marked improvement in water quality without introduction of any significant measures (*ie beyond best practice targets*). This would primarily be due to cessation of the works depot use and stabilisation of the surface as part of upgrade works. However, the concept of transforming the existing coal loader chutes on the platform into small bio-retention systems has been developed to exceed best practice requirements for this demonstration site. MUSIC modelling has also been undertaken to demonstrate the water quality benefit that results for the coal loader platform in addition to the landuse change benefits (*refer to **Appendix A2** for details*).

4.1 MUSIC Model

"MUSIC simulates the performance of a group of stormwater management measures, configured in series or in parallel to form a treatment train." In this case, MUSIC has been run on a continuous basis (30minute intervals from January 1996 to December 1999), allowing rigorous analysis of the merit of proposed strategies over the long-term.

"The adoption of a continuous simulation approach is recommended in water quality modelling. This stems from the fact that impacts of poor stormwater quality on aquatic ecosystem health are associated with cumulative pollutant loads and frequency of aquatic ecosystem "exposure" to poor water quality. Pollutant loads delivered to receiving waters from many of the small storm events (e.g. of magnitude less than the 3 month ARI peak discharge) can make up in excess of 90% of the annual loads discharged from the catchment.

The evaluation of the adequacy's of the stormwater management systems is based on a risk-based approach associated with examination of the long-term mean annual pollutant load delivered to the receiving waters.

MUSIC is designed to simulate stormwater systems in urban catchments and have the capability to operate at a range of temporal and spatial scales, suitable for catchment areas from 0.01 km² to 100 km². Modelling time step can range from 6 minutes to 24 hours to match the range of spatial scale.

The model's algorithms are based on the known performance characteristics of common stormwater quality improvement measures. These data, derived from research undertaken by CRCCH and other organisations, represent the most reliable information currently available in our industry" MUSIC Manual, CRC for Catchment Hydrology (Version 1) May 2002.

4.2 Building Precinct and Coal Loader Platform Areas

Catchment areas that were relevant to both MUSIC models were estimated based upon the site survey and are summarised in **Table 1** below (*refer to **Figure 1** for details*).

For comparison purposes both the existing and proposed conditions MUSIC models that were created for the building precinct area were based on a uniform catchment area of 3,530m². Similarly, the area used for the coal loader platform models was uniform at 8,370m².

Under both existing and proposed conditions in the building precinct area the surface catchments draining to the wetland were assumed to be approximately 70% impervious, whilst both the roofs and road/carparking areas were assumed to be 100% impervious.

For the coal loader platform area, both existing and proposed conditions surface catchments were assumed to be 100% impervious, however only 50% of the area was assumed to be serviced by the proposed chute bio-retention systems under proposed conditions.

Table 1 - Site Sub-Catchment Areas

Precinct	Sub Catchment	Area (m ²)
Administration Building Precinct	A	268
	B	130
	C	125
	D	225
	E	109
	F	2,673
	Total	3,530
Coal Loader Platform	CL1	8,370
	Total	8,370

4.3 Building Precinct MUSIC Model Scenarios

Two MUSIC models were created for the building precinct area. The first assessed the existing conditions, where approximately 1,576m² of catchment is directed to the 430m² wetland and the remaining 1,954m² bypasses the wetland. The second model assessed the proposed conditions, whereby 660m² of carparking area and road at the eastern edge of the site would be serviced by a bio-retention swale, 750m² of roof area is directed to a 50KL on site rainwater tank (*connected to reuse and with the overflow being directed to wetland*) and the remaining 2,122m² has been directed directly to the wetland via drainage improvements onsite.

4.4 Coal Loader Platform MUSIC Model Scenarios

Two MUSIC models were created for the coal loader platform area. The first assessed the pre-development conditions, where no specific water quality measures exist but the land use has been modified from its previous work depot use to a paved parkland area use. The second model assessed the proposed conditions, whereby 50% of the coal loader platform area was directed to bio-retention systems retrofitted to the existing 20 coal loader chutes.

4.5 Rainfall and Evaporation

Rainfall and evaporation data used for all MUSIC modelling was sourced from the Bureau of Meteorology (*BoM*).

Thirty minute rainfall data was utilised for a range of rainfall years representing a mix of average, wet and dry years for the region (*1996 to 1999*).

Details of the rainfall records are included in **Appendix A**. The average annual rainfall depth used was 1,402mm (*ie from 1996 to 1999*). The long term average for the region is approximately 1,100 mm/yr. Hence, the historical period assessed was marginally wetter than the average.

4.6 Rainfall/Runoff Parameters

The default MUSIC rainfall/runoff parameters were used for this preliminary analysis. It should be noted that the model is "*significantly more sensitive to the accurate definition of the fraction impervious and the selection of simulation time step*" MUSIC Manual (CRCCH, 2002).

4.7 Pollutant Loads

The default MUSIC "Urban State" pollutant load parameters were used for this preliminary analysis.

4.8 Pollutant Reduction Assumptions

The following treatment assumptions were made for the existing and proposed water quality measures:

- The existing and proposed wetland has a surface area of approximately 430m², has an average 0.3m depth and has an extended detention depth above the still water level of 0.2m;
- A 2m wide bio retention swale with an extended detention depth of 0.2m will be constructed to serve the access road/carpark area to the east of the administration building precinct. The swale would also contain a 1m wide gravel trench below that is 0.7m deep. The catchment area draining to the swale was assumed to be approximately 660m², with the outflow after treatment discharging to the wetland;
- The surface catchment area draining to the wetland is increased to 2,013m² under the proposed conditions via improved drainage;
- The roof area of building E (109m²) is drained directly to the wetland under the proposed conditions;
- A 50KL tank is connected to the roof drainage of buildings A,B,C and D, with a total roof catchment of 750m². The runoff collected would be reused at a rate of 2.2KL/day and the overflow directed to the wetland; and
- Twenty individual bio-retention systems would be installed within the existing coal loader chutes totalling a surface and filter area of 180m², each with an extended detention depth of 0.15m, filter depth of 0.7m and adoption of filter media to achieve an infiltration rate of 100mm/h.

4.9 MUSIC Modelling Results

Tables 2 and 3 includes a summary of the estimated annual pollutant loads for both the existing and proposed development scenarios within the developed areas of the administration building precinct and the coal loader platform.

4.91 Building Precinct

The existing condition results show that the existing wetland is achieving a high treatment effectiveness, primarily due to the relatively small catchment that it serves. Combined with the developed areas of the building precinct that achieve no formal treatment, the result is an

annual load at the outlet of approximately 440kg/y, 1.0kg/yr, 7.7kg/y and 51.4kg/yr for TSS, TP, TN and gross pollutants respectively.

Under proposed conditions with an increase of catchment area draining to the wetland along with implementation of the bio-retention swale and rainwater tank/reuse system, the level of treatment is improved at the outlet. The result is an annual load at the outlet of approximately 20.8kg/y, 0.3kg/yr, 4.1kg/y and 0kg/yr for TSS, TP, TN and gross pollutants respectively. This is a marked improvement over the existing conditions (*ie a reduction of 95%, 74%, 46% and 100% for TSS, TP, TN and gross pollutants respectively*). With the increase in catchment area, the existing wetland still maintains a high treatment effectiveness, which is not unexpected as it still has a surface area that is approximately 12% of the upstream catchment.

An objective that is commonly adopted for new developments by the NSW DEC and many Councils throughout Sydney is a target of 80%, 45, 45% reduction in TS, TP and TN respectively. The outcome accomplished as a result of the proposed treatment systems for the building precinct area at the coal loader site not only achieves this objective but exceeds it.

4.92 Coal Loader Platform

Under pre development conditions the MUSIC model predicts that the coal loader platform under a conversion of landuse to parkland is generating an annual load at the outlet of approximately 2,150kg/y, 4.3kg/yr, 31.3kg/y and 257kg/yr for TSS, TP, TN and gross pollutants respectively.

When 50% of the coal loader platform area is redirected towards the proposed chute bio-retention systems the annual pollutant loads are reduced at the outlet to 1,310kg/y, 3.1kg/yr, 24.1kg/y and 128kg/yr for TSS, TP, TN and gross pollutants respectively. This is a treatment effectiveness at the outlet of 39%, 29%, 23% and 50% for TSS, TP, TN and gross pollutants respectively. Note that the treatment effectiveness of the units themselves (*ie when not combined with the untreated catchments*) is 85%, 64%, 43% and 100% for TSS, TP, TN and gross pollutants respectively.

Considering that the change in landuse from its current work depot use to parkland will bring about substantial improvement in existing loads discharged from the coal loader platform area, the additional outcome provided by the bio-retention systems is acceptable.

Table 2 - Estimated Average Annual Runoff Pollutant Loads (*Administration Building Precinct*)

Scenario & Catchment	Runoff (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Existing					
Ex Cat (<i>to wetland</i>)	1.71	341	0.691	4.85	41.1
Ex Cat 2 (<i>bypassing wetland</i>)	2.13	433	0.895	6.17	51.4
Out	3.19	440	0.993	7.67	51.4
Cv	0.65				

Scenario & Catchment	Runoff (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Proposed					
Prop Cat 1 (to rainwater tank and wetland)	1.02	204	0.422	2.87	24.4
Prop Cat 2 (to wetland)	2.1	451	0.889	6.04	50.0
Road (to bio swale and wetland)	0.891	174	0.354	2.58	21.4
Out	2.73	20.8	0.263	4.14	0
Cv	0.55				
Reduction Below Existing (%)*	14%	95%	74%	46%	100%

Notes

* Compared with existing at outlet

Table 3 - Estimated Average Annual Runoff Pollutant Loads (Coal Loader Platform)

Scenario & Catchment	Runoff (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Existing					
Out	10.7	2150	4.34	31.3	257
Cv					
Proposed					
Out	10.7	1310	3.08	24.1	128
Cv					
Reduction Below Existing (%)*	0%	39%	29%	23%	50%

Notes

* Compared with existing at outlet

5. IMPROVED DRAINAGE

For the proposed future parkland use, the general drainage systems provided on site will need to be improved to modern day best practice to prevent nuisance flooding and erosion.

On the coal loader platform, it is recommended that a major/minor system be designed in accordance with the principles of ARR87 to ensure that this flat area drains adequately. In addition, drainage into and from the tunnel system below will also need to be improved.

For the building precinct area, the drainage collection and conveyance systems will also need to be improved to achieve the assumptions made in both the MUSIC and Water Balance modelling. This will require improving roof drainage systems to ensure all roof water is conveyed to the proposed rainwater tank on site. Overflow from this system will need to be piped to the existing wetland and surface drainage systems improved around the existing buildings to also collect and convey runoff from these areas to the wetland.

For the parking/road area to the east of the building precinct area, road surfaces would need to be regraded to drain to the proposed swale for treatment and then conveyance to the existing wetland.

Wetland inflow/outflow system may also need to be improved to ensure proper operation.

The remaining landscaped and paved areas of the site would be treated in accordance with best practice drainage design as required.

A conceptual design of the drainage system improvements recommended is illustrated in **Figure 2**. All piped drainage capacity would be designed to cater for the 20yr ARI event, whilst overland flows would be safely conveyed to the receiving waters in the 100yr ARI event.

6. RECOMENDATIONS

Our assessment has lead to the following recommendations for the proposed Coal Loader site parkland:

1. Reuse of roof water from Buildings A,B,C and D be adopted by utilising storage within a 50KL tank that is linked for reuse of stored water in all toilet's on site as well as in a small automated irrigation system;
2. Overflow from the 50KL tank is to be directly connect to the wetland;
3. The existing septic tank on site is to be disconnected and all sewerage generated by the site be connected to the nearby Sydney Water sewerage system;
4. The existing wetland on site should remain and undergo minor upgrades to the inlet/outlet systems only;
5. The drainage systems around the buildings within the building precinct be improved to direct more runoff to the existing wetland;
6. The roof drainage from Building E be connected directly to the wetland;
7. Litter control devices (*ie pit inserts or GPT's*) be incorporated within the sites upgraded drainage design;
8. The drainage systems on the coal loader platform and from the tunnels beneath be improved to best practice standard;
9. The viability and cost of a system collecting runoff from the surface of the coal loader platform for storage in the tunnels, treatment and reuse in special events be investigated further;
10. The showcasing of various backyard scale demonstration units (*non operational*) of black and grey water reuse technologies should be further investigated with manufacturers; and
11. Bio-retention systems be retrofitted within the existing coal loader chutes to treat part of the coal loader platform surface.

We trust this information is satisfactory. Should you have any further enquiries, please do not hesitate to contact either Michael Shaw or myself on (02) 9957 1619.


Yours faithfully
PATTERSON BRITTON



Mark Tooker
Principal

Review / Verification by

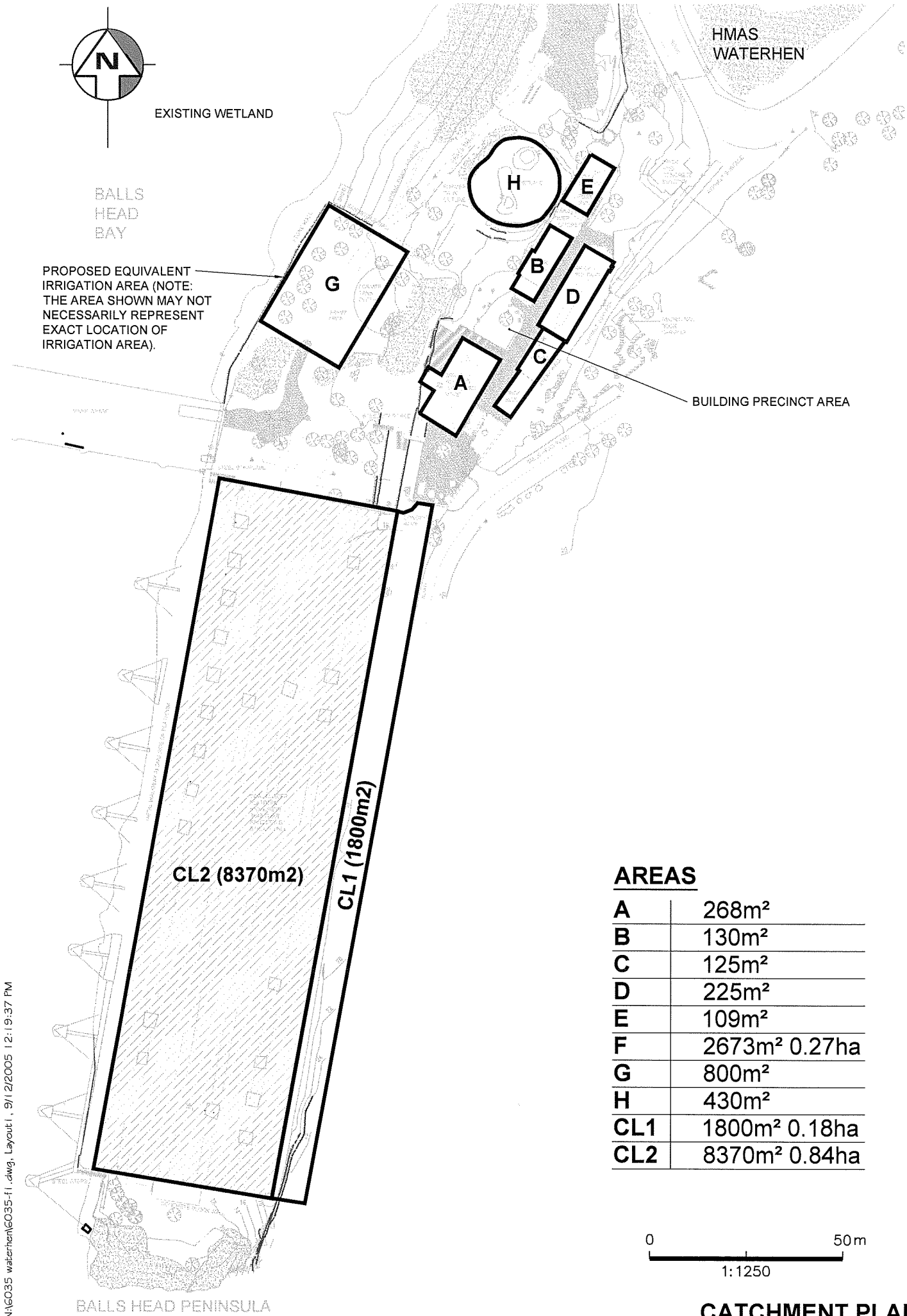
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FIGURES

FIGURE 1

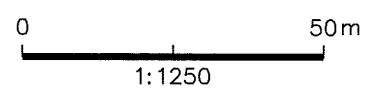


PROPOSED EQUIVALENT IRRIGATION AREA (NOTE: THE AREA SHOWN MAY NOT NECESSARILY REPRESENT EXACT LOCATION OF IRRIGATION AREA).

BUILDING PRECINCT AREA

AREAS

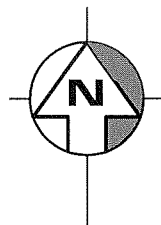
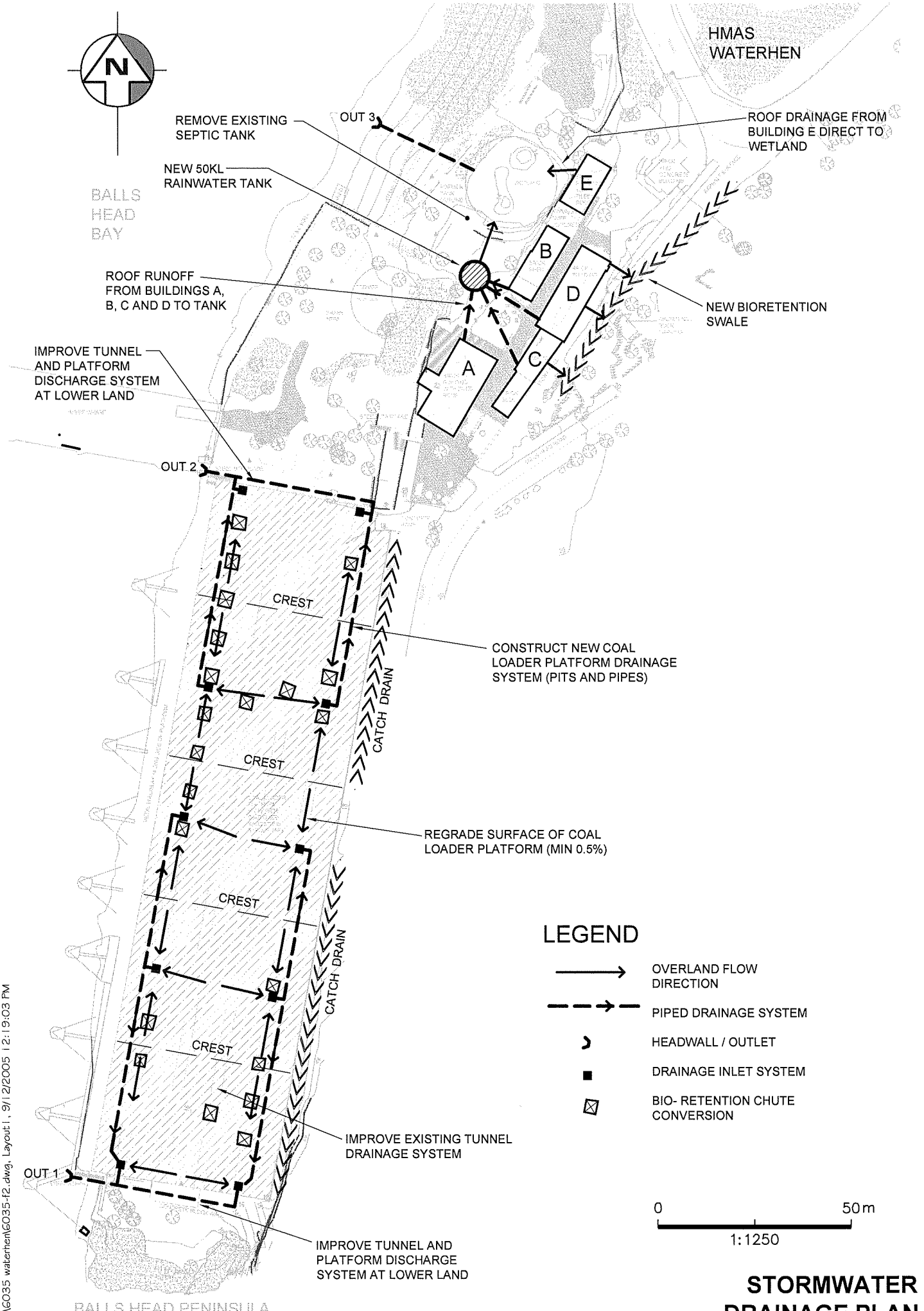
A	268m ²
B	130m ²
C	125m ²
D	225m ²
E	109m ²
F	2673m ² 0.27ha
G	800m ²
H	430m ²
CL1	1800m ² 0.18ha
CL2	8370m ² 0.84ha



CATCHMENT PLAN

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FIGURE 2



HMAS WATERHEN

BALLS HEAD BAY

REMOVE EXISTING SEPTIC TANK

NEW 50KL RAINWATER TANK

ROOF RUNOFF FROM BUILDINGS A, B, C AND D TO TANK

IMPROVE TUNNEL AND PLATFORM DISCHARGE SYSTEM AT LOWER LAND

NEW BIORETENTION SWALE

OUT 2

CREST

CONSTRUCT NEW COAL LOADER PLATFORM DRAINAGE SYSTEM (PITS AND PIPES)

CREST

REGRADE SURFACE OF COAL LOADER PLATFORM (MIN 0.5%)

CREST

LEGEND

- OVERLAND FLOW DIRECTION
- - - PIPED DRAINAGE SYSTEM
- ⌋ HEADWALL / OUTLET
- DRAINAGE INLET SYSTEM
- ⊠ BIO-RETENTION CHUTE CONVERSION

0 50m
1:1250

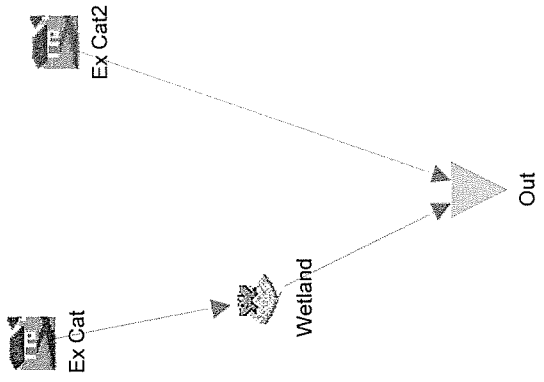
STORMWATER DRAINAGE PLAN

BALLS HEAD PENINSULA

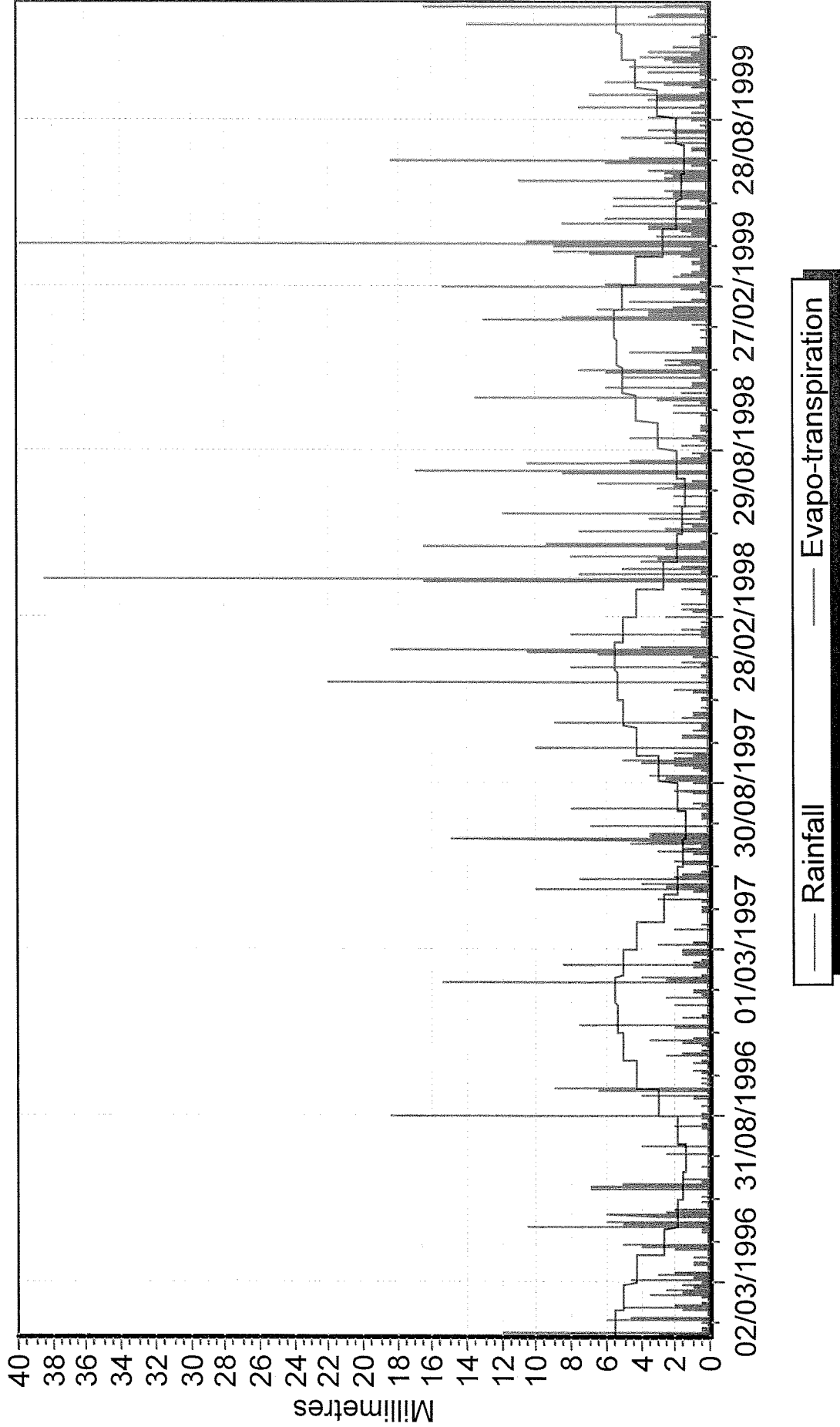
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APPENDIX A – MUSIC MODELLING DATA/RESULTS

APPENDIX A1



6035-existing



Exit (A1.)

Source nodes

Location, Ex Cat (ID = 2), Ex Cat2 (ID = 4)
Node Type, Urban Source Node, Urban Source Node
Total Area (ha), 0.158, 0.195
Area Impervious (ha), 0.110496052631579, 0.136371710526316
Area Pervious (ha), 0.0475039473684211, 0.0586282894736842
Field Capacity (mm), 50, 50
Pervious Area Infiltration Capacity coefficient - a, 50, 50
Pervious Area Infiltration Capacity exponent - b, 2, 2
Impervious Area Rainfall Threshold (mm/day), 1, 1
Pervious Area Soil Storage Capacity (mm), 150, 150
Pervious Area Soil Initial Storage (% of Capacity), 25, 25
Groundwater Initial Depth (mm), 50, 50
Groundwater Daily Recharge Rate (%), 0.65, 0.65
Groundwater Daily Baseflow Rate (%), 0.85, 0.85
Groundwater Daily Deep Seepage Rate (%), 0, 0
Stormflow Total Suspended Solids Mean (log mg/L), 2.2, 2.2
Stormflow Total Suspended Solids Standard Deviation (log mg/L), 0.32, 0.32
Stormflow Total Suspended Solids Estimation Method, Stochastic, Stochastic
Stormflow Total Suspended Solids Serial Correlation, 0, 0
Stormflow Total Phosphorus Mean (log mg/L), -0.45, -0.45
Stormflow Total Phosphorus Standard Deviation (log mg/L), 0.25, 0.25
Stormflow Total Phosphorus Estimation Method, Stochastic, Stochastic
Stormflow Total Phosphorus Serial Correlation, 0, 0
Stormflow Total Nitrogen Mean (log mg/L), 0.42, 0.42
Stormflow Total Nitrogen Standard Deviation (log mg/L), 0.19, 0.19
Stormflow Total Nitrogen Estimation Method, Stochastic, Stochastic
Stormflow Total Nitrogen Serial Correlation, 0, 0
Baseflow Total Suspended Solids Mean (log mg/L), 1.1, 1.1
Baseflow Total Suspended Solids Standard Deviation (log mg/L), 0.17, 0.17
Baseflow Total Suspended Solids Estimation Method, Stochastic, Stochastic
Baseflow Total Suspended Solids Serial Correlation, 0, 0
Baseflow Total Phosphorus Mean (log mg/L), -0.82, -0.82
Baseflow Total Phosphorus Standard Deviation (log mg/L), 0.19, 0.19
Baseflow Total Phosphorus Estimation Method, Stochastic, Stochastic
Baseflow Total Phosphorus Serial Correlation, 0, 0
Baseflow Total Nitrogen Mean (log mg/L), 0.32, 0.32
Baseflow Total Nitrogen Standard Deviation (log mg/L), 0.12, 0.12
Baseflow Total Nitrogen Estimation Method, Stochastic, Stochastic
Baseflow Total Nitrogen Serial Correlation, 0, 0
OUT - Mean Annual Flow (ML/yr), 0.00, 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00, 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00, 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00, 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00, 0.00

No Imported Data Source nodes

USTM treatment nodes

Location, Wetland (ID = 3)
Node Type, Wetland Node
Lo-flow bypass rate (cum/sec), 0
Hi-flow bypass rate (cum/sec), 100
Inlet pond volume, 0
Area (sqm), 430
Extended detention depth (m), 0.2
Permanent pool volume (cum), 130
Proportion vegetated, 0.5
Equivalent pipe diameter (mm), 200
Overflow weir width (m), 3
Notional Detention Time (hrs), 0.573
Orifice discharge coefficient, 0.6
Weir coefficient, 1.7
Number of CSTR cells, 5
Total Suspended Solids k (m/yr), 5000
Total Suspended Solids C* (mg/L), 6

Total Suspended Solids C** (mg/L), 6
Total Phosphorus k (m/yr), 2800
Total Phosphorus C* (mg/L), 0.09
Total Phosphorus C** (mg/L), 0.09
Total Nitrogen k (m/yr), 500
Total Nitrogen C* (mg/L), 1.3
Total Nitrogen C** (mg/L), 1.3
Threshold hydraulic loading for C** (m/yr), 3500
Extraction for Re-use, Off
Annual Re-use Demand - scaled by daily PET (ML),
Constant Daily Re-use Demand (kL),
User-defined Annual Re-use Demand (ML),
Percentage of User-defined Annual Re-use Demand Jan,
Percentage of User-defined Annual Re-use Demand Feb,
Percentage of User-defined Annual Re-use Demand Mar,
Percentage of User-defined Annual Re-use Demand Apr,
Percentage of User-defined Annual Re-use Demand May,
Percentage of User-defined Annual Re-use Demand Jun,
Percentage of User-defined Annual Re-use Demand Jul,
Percentage of User-defined Annual Re-use Demand Aug,
Percentage of User-defined Annual Re-use Demand Sep,
Percentage of User-defined Annual Re-use Demand Oct,
Percentage of User-defined Annual Re-use Demand Nov,
Percentage of User-defined Annual Re-use Demand Dec,
Filter area (sqm),
Filter depth (m),
Filter particle effective diameter (mm),
Saturated hydraulic conductivity (mm/hr),
Voids ratio,
Length (m),
Bed slope,
Base Width (m),
Top width (m),
Vegetation height (m),
Proportion of upstream impervious area treated,
Seepage Rate (mm/hr), 0
Evap Loss as proportion of PET, 1.25
Depth in metres below the drain pipe,
IN - Mean Annual Flow (ML/yr), 0.00
IN - TSS Mean Annual Load (kg/yr), 0.00
IN - TP Mean Annual Load (kg/yr), 0.00
IN - TN Mean Annual Load (kg/yr), 0.00
IN - Gross Pollutant Mean Annual Load (kg/yr), 0.00
OUT - Mean Annual Flow (ML/yr), 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00

No Generic treatment nodes

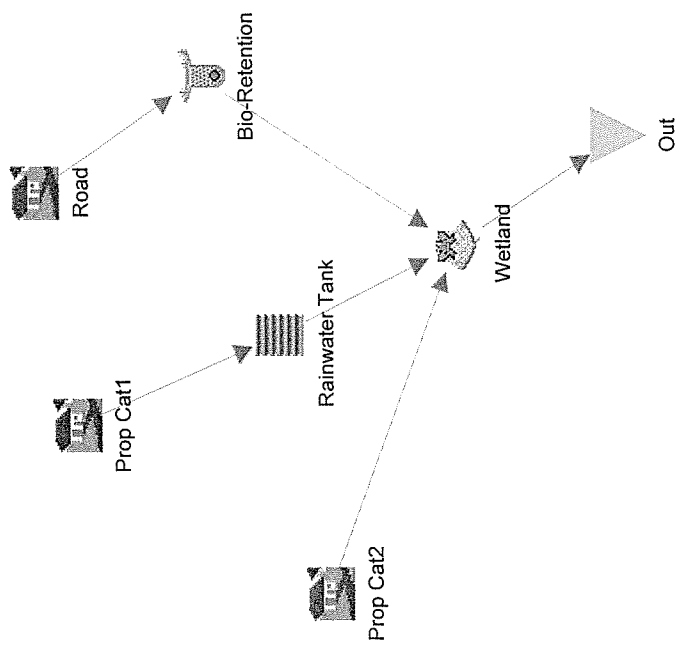
Other nodes

,Out (ID = 1)
IN - Mean Annual Flow (ML/yr), 0.00
IN - TSS Mean Annual Load (kg/yr), 0.00
IN - TP Mean Annual Load (kg/yr), 0.00
IN - TN Mean Annual Load (kg/yr), 0.00
IN - Gross Pollutant Mean Annual Load (kg/yr), 0.00
OUT - Mean Annual Flow (ML/yr), 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00

Links

,Drainage Link, Drainage Link, Drainage Link

Source node,Ex Cat (ID = 2),Wetland (ID = 3),Ex Cat2 (ID = 4)
Target node,Wetland (ID = 3),Out (ID = 1),Out (ID = 1)
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed
Muskingum K,,,
Muskingum theta,,,
IN - Mean Annual Flow (ML/yr),0.00,0.00,0.00
IN - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00
IN - TP Mean Annual Load (kg/yr),0.00,0.00,0.00
IN - TN Mean Annual Load (kg/yr),0.00,0.00,0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00
OUT - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00



Proposed(A)

Source nodes

Location, Prop Cat1 (ID = 2), Prop Cat2 (ID = 5), Road (ID = 6)
Node Type, Urban Source Node, Urban Source Node, Urban Source Node
Total Area (ha), 0.075, 0.212, 0.066
Area Impervious (ha), 0.075, 0.126660701754386, 0.066
Area Pervious (ha), 0, 0.0853392982456141, 0
Field Capacity (mm), 50, 50, 50
Pervious Area Infiltration Capacity coefficient - a, 50, 50, 50
Pervious Area Infiltration Capacity exponent - b, 2, 2, 2
Impervious Area Rainfall Threshold (mm/day), 1, 1, 1
Pervious Area Soil Storage Capacity (mm), 150, 150, 150
Pervious Area Soil Initial Storage (% of Capacity), 25, 25, 25
Groundwater Initial Depth (mm), 50, 50, 50
Groundwater Daily Recharge Rate (%), 0.65, 0.65, 0.65
Groundwater Daily Baseflow Rate (%), 0.85, 0.85, 0.85
Groundwater Daily Deep Seepage Rate (%), 0, 0, 0
Stormflow Total Suspended Solids Mean (log mg/L), 2.2, 2.2, 2.2
Stormflow Total Suspended Solids Standard Deviation (log mg/L), 0.32, 0.32, 0.32
Stormflow Total Suspended Solids Estimation Method, Stochastic, Stochastic, Stochastic
Stormflow Total Suspended Solids Serial Correlation, 0, 0, 0
Stormflow Total Phosphorus Mean (log mg/L), -0.45, -0.45, -0.45
Stormflow Total Phosphorus Standard Deviation (log mg/L), 0.25, 0.25, 0.25
Stormflow Total Phosphorus Estimation Method, Stochastic, Stochastic, Stochastic
Stormflow Total Phosphorus Serial Correlation, 0, 0, 0
Stormflow Total Nitrogen Mean (log mg/L), 0.42, 0.42, 0.42
Stormflow Total Nitrogen Standard Deviation (log mg/L), 0.19, 0.19, 0.19
Stormflow Total Nitrogen Estimation Method, Stochastic, Stochastic, Stochastic
Stormflow Total Nitrogen Serial Correlation, 0, 0, 0
Baseflow Total Suspended Solids Mean (log mg/L), 1.1, 1.1, 1.1
Baseflow Total Suspended Solids Standard Deviation (log mg/L), 0.17, 0.17, 0.17
Baseflow Total Suspended Solids Estimation Method, Stochastic, Stochastic, Stochastic
Baseflow Total Suspended Solids Serial Correlation, 0, 0, 0
Baseflow Total Phosphorus Mean (log mg/L), -0.82, -0.82, -0.82
Baseflow Total Phosphorus Standard Deviation (log mg/L), 0.19, 0.19, 0.19
Baseflow Total Phosphorus Estimation Method, Stochastic, Stochastic, Stochastic
Baseflow Total Phosphorus Serial Correlation, 0, 0, 0
Baseflow Total Nitrogen Mean (log mg/L), 0.32, 0.32, 0.32
Baseflow Total Nitrogen Standard Deviation (log mg/L), 0.12, 0.12, 0.12
Baseflow Total Nitrogen Estimation Method, Stochastic, Stochastic, Stochastic
Baseflow Total Nitrogen Serial Correlation, 0, 0, 0
OUT - Mean Annual Flow (ML/yr), 0.00, 0.00, 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00, 0.00, 0.00

No Imported Data Source nodes

USTM treatment nodes

Location, Wetland (ID = 3), Rainwater Tank (ID = 4), Bio-Retention (ID = 7)
Node Type, Wetland Node, Rainwater Tank Node, Bio-Retention System Node
Lo-flow bypass rate (cum/sec), 0, 0, 0
Hi-flow bypass rate (cum/sec), 100, 100, 100
Inlet pond volume, 0, 0,
Area (sqm), 430, 33.3, 200
Extended detention depth (m), 0.2, 1.5, 0.2
Permanent pool volume (cum), 130, 50,
Proportion vegetated, 0.5, 0,
Equivalent pipe diameter (mm), 200, 50,
Overflow weir width (m), 3, 10, 2

Notional Detention Time (hrs),0.573,1.94,
 Orifice discharge coefficient,0.6,0.6,
 Weir coefficient,1.7,1.7,1.7
 Number of CSTR cells,5,2,3
 Total Suspended Solids k (m/yr),5000,400,1000
 Total Suspended Solids C* (mg/L),6,12,12
 Total Suspended Solids C** (mg/L),6,12,
 Total Phosphorus k (m/yr),2800,300,500
 Total Phosphorus C* (mg/L),0.09,0.13,0.13
 Total Phosphorus C** (mg/L),0.09,0.13,
 Total Nitrogen k (m/yr),500,40,50
 Total Nitrogen C* (mg/L),1.3,1.4,1.3
 Total Nitrogen C** (mg/L),1.3,1.4,
 Threshold hydraulic loading for C** (m/yr),3500,3500,
 Extraction for Re-use,Off,On,Off
 Annual Re-use Demand - scaled by daily PET (ML),,0,
 Constant Daily Re-use Demand (kL),,2.2,
 User-defined Annual Re-use Demand (ML),,0,
 Percentage of User-defined Annual Re-use Demand Jan,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Feb,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Mar,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Apr,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand May,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Jun,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Jul,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Aug,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Sep,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Oct,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Nov,,8.3333333333333333,
 Percentage of User-defined Annual Re-use Demand Dec,,8.3333333333333333,
 Filter area (sqm),,,100
 Filter depth (m),,,0.7
 Filter particle effective diameter (mm),,,5
 Saturated hydraulic conductivity (mm/hr),,,100
 Voids ratio,,0.3
 Length (m),,,
 Bed slope,,
 Base Width (m),,,
 Top width (m),,,
 Vegetation height (m),,,
 Proportion of upstream impervious area treated,,
 Seepage Rate (mm/hr),0,0,0
 Evap Loss as proportion of PET,1.25,0,
 Depth in metres below the drain pipe,,0
 IN - Mean Annual Flow (ML/yr),0.00,0.00,0.00
 IN - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00
 IN - TP Mean Annual Load (kg/yr),0.00,0.00,0.00
 IN - TN Mean Annual Load (kg/yr),0.00,0.00,0.00
 IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00
 OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00
 OUT - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00
 OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00
 OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00
 OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00

No Generic treatment nodes

Other nodes

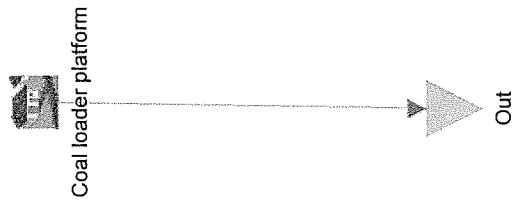
,Out (ID = 1)
 IN - Mean Annual Flow (ML/yr),0.00
 IN - TSS Mean Annual Load (kg/yr),0.00
 IN - TP Mean Annual Load (kg/yr),0.00
 IN - TN Mean Annual Load (kg/yr),0.00
 IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
 OUT - Mean Annual Flow (ML/yr),0.00
 OUT - TSS Mean Annual Load (kg/yr),0.00

OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00

Links

,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node,Wetland (ID = 3),Prop Cat2 (ID = 5),Prop Cat1 (ID = 2),Rainwater Tank (ID = 4),Road (ID = 6),Bio-Retention (ID = 7)
Target node,Out (ID = 1),Wetland (ID = 3),Rainwater Tank (ID = 4),Wetland (ID = 3),Bio-Retention (ID = 7),Wetland (ID = 3)
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K,,,,,,,,
Muskingum theta,,,,,,,,
IN - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00,0.00
IN - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
IN - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
IN - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
OUT - Mean Annual Flow (ML/yr),0.00,0.00,0.00,0.00,0.00,0.00
OUT - TSS Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
OUT - TP Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
OUT - TN Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00,0.00,0.00,0.00

APPENDIX A2



Existing (A2)

Source nodes

Location, Coal loader platform (ID = 2)
Node Type, Urban Source Node
Total Area (ha), 0.837
Area Impervious (ha), 0.837
Area Pervious (ha), 0
Field Capacity (mm), 50
Pervious Area Infiltration Capacity coefficient - a, 50
Pervious Area Infiltration Capacity exponent - b, 2
Impervious Area Rainfall Threshold (mm/day), 1
Pervious Area Soil Storage Capacity (mm), 150
Pervious Area Soil Initial Storage (% of Capacity), 25
Groundwater Initial Depth (mm), 50
Groundwater Daily Recharge Rate (%), 0.65
Groundwater Daily Baseflow Rate (%), 0.85
Groundwater Daily Deep Seepage Rate (%), 0
Stormflow Total Suspended Solids Mean (log mg/L), 2.2
Stormflow Total Suspended Solids Standard Deviation (log mg/L), 0.32
Stormflow Total Suspended Solids Estimation Method, Stochastic
Stormflow Total Suspended Solids Serial Correlation, 0
Stormflow Total Phosphorus Mean (log mg/L), -0.45
Stormflow Total Phosphorus Standard Deviation (log mg/L), 0.25
Stormflow Total Phosphorus Estimation Method, Stochastic
Stormflow Total Phosphorus Serial Correlation, 0
Stormflow Total Nitrogen Mean (log mg/L), 0.42
Stormflow Total Nitrogen Standard Deviation (log mg/L), 0.19
Stormflow Total Nitrogen Estimation Method, Stochastic
Stormflow Total Nitrogen Serial Correlation, 0
Baseflow Total Suspended Solids Mean (log mg/L), 1.1
Baseflow Total Suspended Solids Standard Deviation (log mg/L), 0.17
Baseflow Total Suspended Solids Estimation Method, Stochastic
Baseflow Total Suspended Solids Serial Correlation, 0
Baseflow Total Phosphorus Mean (log mg/L), -0.82
Baseflow Total Phosphorus Standard Deviation (log mg/L), 0.19
Baseflow Total Phosphorus Estimation Method, Stochastic
Baseflow Total Phosphorus Serial Correlation, 0
Baseflow Total Nitrogen Mean (log mg/L), 0.32
Baseflow Total Nitrogen Standard Deviation (log mg/L), 0.12
Baseflow Total Nitrogen Estimation Method, Stochastic
Baseflow Total Nitrogen Serial Correlation, 0
OUT - Mean Annual Flow (ML/yr), 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00

No Imported Data Source nodes

No USTM treatment nodes

No Generic treatment nodes

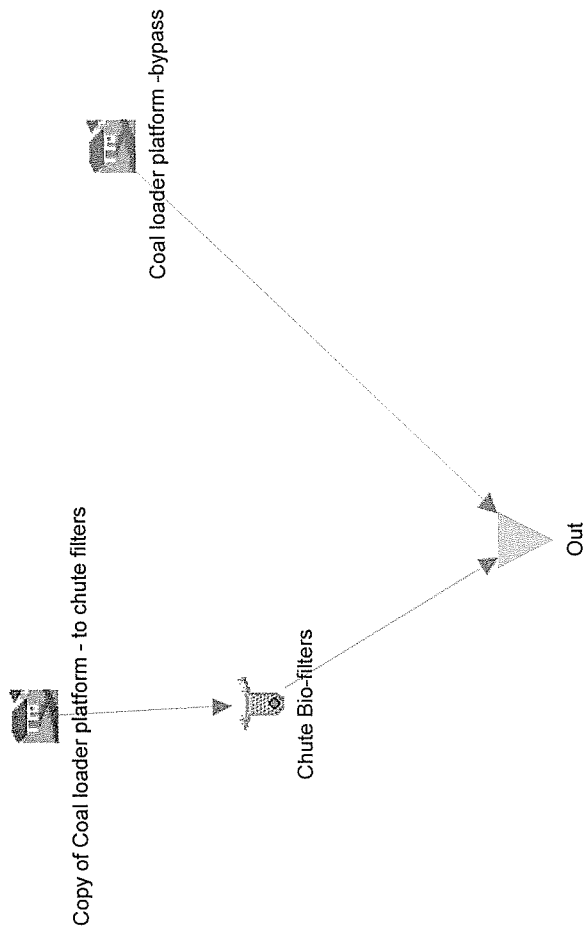
Other nodes

,Out (ID = 1)
IN - Mean Annual Flow (ML/yr), 0.00
IN - TSS Mean Annual Load (kg/yr), 0.00
IN - TP Mean Annual Load (kg/yr), 0.00
IN - TN Mean Annual Load (kg/yr), 0.00
IN - Gross Pollutant Mean Annual Load (kg/yr), 0.00
OUT - Mean Annual Flow (ML/yr), 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00

Links

1/2

, Drainage Link
Source node, Coal loader platform (ID = 2)
Target node, Out (ID = 1)
Muskingum-Cunge Routing, Not Routed
Muskingum K,
Muskingum theta,
IN - Mean Annual Flow (ML/yr), 0.00
IN - TSS Mean Annual Load (kg/yr), 0.00
IN - TP Mean Annual Load (kg/yr), 0.00
IN - TN Mean Annual Load (kg/yr), 0.00
IN - Gross Pollutant Mean Annual Load (kg/yr), 0.00
OUT - Mean Annual Flow (ML/yr), 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00



proposed (AZ)

Source nodes

Location, Coal loader platform -bypass (ID = 2), Copy of Coal loader platform
- to chute filters (ID = 3)
Node Type, Urban Source Node, Urban Source Node
Total Area (ha), 0.418, 0.419
Area Impervious (ha), 0.418, 0.419
Area Pervious (ha), 0, 0
Field Capacity (mm), 50, 50
Pervious Area Infiltration Capacity coefficient - a, 50, 50
Pervious Area Infiltration Capacity exponent - b, 2, 2
Impervious Area Rainfall Threshold (mm/day), 1, 1
Pervious Area Soil Storage Capacity (mm), 150, 150
Pervious Area Soil Initial Storage (% of Capacity), 25, 25
Groundwater Initial Depth (mm), 50, 50
Groundwater Daily Recharge Rate (%), 0.65, 0.65
Groundwater Daily Baseflow Rate (%), 0.85, 0.85
Groundwater Daily Deep Seepage Rate (%), 0, 0
Stormflow Total Suspended Solids Mean (log mg/L), 2.2, 2.2
Stormflow Total Suspended Solids Standard Deviation (log mg/L), 0.32, 0.32
Stormflow Total Suspended Solids Estimation Method, Stochastic, Stochastic
Stormflow Total Suspended Solids Serial Correlation, 0, 0
Stormflow Total Phosphorus Mean (log mg/L), -0.45, -0.45
Stormflow Total Phosphorus Standard Deviation (log mg/L), 0.25, 0.25
Stormflow Total Phosphorus Estimation Method, Stochastic, Stochastic
Stormflow Total Phosphorus Serial Correlation, 0, 0
Stormflow Total Nitrogen Mean (log mg/L), 0.42, 0.42
Stormflow Total Nitrogen Standard Deviation (log mg/L), 0.19, 0.19
Stormflow Total Nitrogen Estimation Method, Stochastic, Stochastic
Stormflow Total Nitrogen Serial Correlation, 0, 0
Baseflow Total Suspended Solids Mean (log mg/L), 1.1, 1.1
Baseflow Total Suspended Solids Standard Deviation (log mg/L), 0.17, 0.17
Baseflow Total Suspended Solids Estimation Method, Stochastic, Stochastic
Baseflow Total Suspended Solids Serial Correlation, 0, 0
Baseflow Total Phosphorus Mean (log mg/L), -0.82, -0.82
Baseflow Total Phosphorus Standard Deviation (log mg/L), 0.19, 0.19
Baseflow Total Phosphorus Estimation Method, Stochastic, Stochastic
Baseflow Total Phosphorus Serial Correlation, 0, 0
Baseflow Total Nitrogen Mean (log mg/L), 0.32, 0.32
Baseflow Total Nitrogen Standard Deviation (log mg/L), 0.12, 0.12
Baseflow Total Nitrogen Estimation Method, Stochastic, Stochastic
Baseflow Total Nitrogen Serial Correlation, 0, 0
OUT - Mean Annual Flow (ML/yr), 0.00, 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00, 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00, 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00, 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00, 0.00

No Imported Data Source nodes

USTM treatment nodes

Location, Chute Bio-filters (ID = 4)
Node Type, Bio-Retention System Node
Lo-flow bypass rate (cum/sec), 0
Hi-flow bypass rate (cum/sec), 100
Inlet pond volume,
Area (sqm), 180
Extended detention depth (m), 0.15
Permanent pool volume (cum),
Proportion vegetated,
Equivalent pipe diameter (mm),
Overflow weir width (m), 3
Notional Detention Time (hrs),
Orifice discharge coefficient,
Weir coefficient, 1.7
Number of CSTR cells, 3
Total Suspended Solids k (m/yr), 1000

Total Suspended Solids C* (mg/L),12
Total Suspended Solids C** (mg/L),
Total Phosphorus k (m/yr),500
Total Phosphorus C* (mg/L),0.13
Total Phosphorus C** (mg/L),
Total Nitrogen k (m/yr),50
Total Nitrogen C* (mg/L),1.3
Total Nitrogen C** (mg/L),
Threshold hydraulic loading for C** (m/yr),
Extraction for Re-use,Off
Annual Re-use Demand - scaled by daily PET (ML),
Constant Daily Re-use Demand (kL),
User-defined Annual Re-use Demand (ML),
Percentage of User-defined Annual Re-use Demand Jan,
Percentage of User-defined Annual Re-use Demand Feb,
Percentage of User-defined Annual Re-use Demand Mar,
Percentage of User-defined Annual Re-use Demand Apr,
Percentage of User-defined Annual Re-use Demand May,
Percentage of User-defined Annual Re-use Demand Jun,
Percentage of User-defined Annual Re-use Demand Jul,
Percentage of User-defined Annual Re-use Demand Aug,
Percentage of User-defined Annual Re-use Demand Sep,
Percentage of User-defined Annual Re-use Demand Oct,
Percentage of User-defined Annual Re-use Demand Nov,
Percentage of User-defined Annual Re-use Demand Dec,
Filter area (sqm),180
Filter depth (m),0.7
Filter particle effective diameter (mm),5
Saturated hydraulic conductivity (mm/hr),100
Voids ratio,0.3
Length (m),
Bed slope,
Base Width (m),
Top width (m),
Vegetation height (m),
Proportion of upstream impervious area treated,
Seepage Rate (mm/hr),0
Evap Loss as proportion of PET,
Depth in metres below the drain pipe,0
IN - Mean Annual Flow (ML/yr),0.00
IN - TSS Mean Annual Load (kg/yr),0.00
IN - TP Mean Annual Load (kg/yr),0.00
IN - TN Mean Annual Load (kg/yr),0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),0.00
OUT - TSS Mean Annual Load (kg/yr),0.00
OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00

No Generic treatment nodes

Other nodes

,Out (ID = 1)
IN - Mean Annual Flow (ML/yr),0.00
IN - TSS Mean Annual Load (kg/yr),0.00
IN - TP Mean Annual Load (kg/yr),0.00
IN - TN Mean Annual Load (kg/yr),0.00
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),0.00
OUT - TSS Mean Annual Load (kg/yr),0.00
OUT - TP Mean Annual Load (kg/yr),0.00
OUT - TN Mean Annual Load (kg/yr),0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00

Links

, Drainage Link, Drainage Link, Drainage Link
Source node, Coal loader platform -bypass (ID = 2), Copy of Coal loader
platform - to chute filters (ID = 3), Chute Bio-filters (ID = 4)
Target node, Out (ID = 1), Chute Bio-filters (ID = 4), Out (ID = 1)
Muskingum-Cunge Routing, Not Routed, Not Routed, Not Routed
Muskingum K,,,
Muskingum theta,,,
IN - Mean Annual Flow (ML/yr), 0.00, 0.00, 0.00
IN - TSS Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
IN - TP Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
IN - TN Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
IN - Gross Pollutant Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - Mean Annual Flow (ML/yr), 0.00, 0.00, 0.00
OUT - TSS Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - TP Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - TN Mean Annual Load (kg/yr), 0.00, 0.00, 0.00
OUT - Gross Pollutant Mean Annual Load (kg/yr), 0.00, 0.00, 0.00