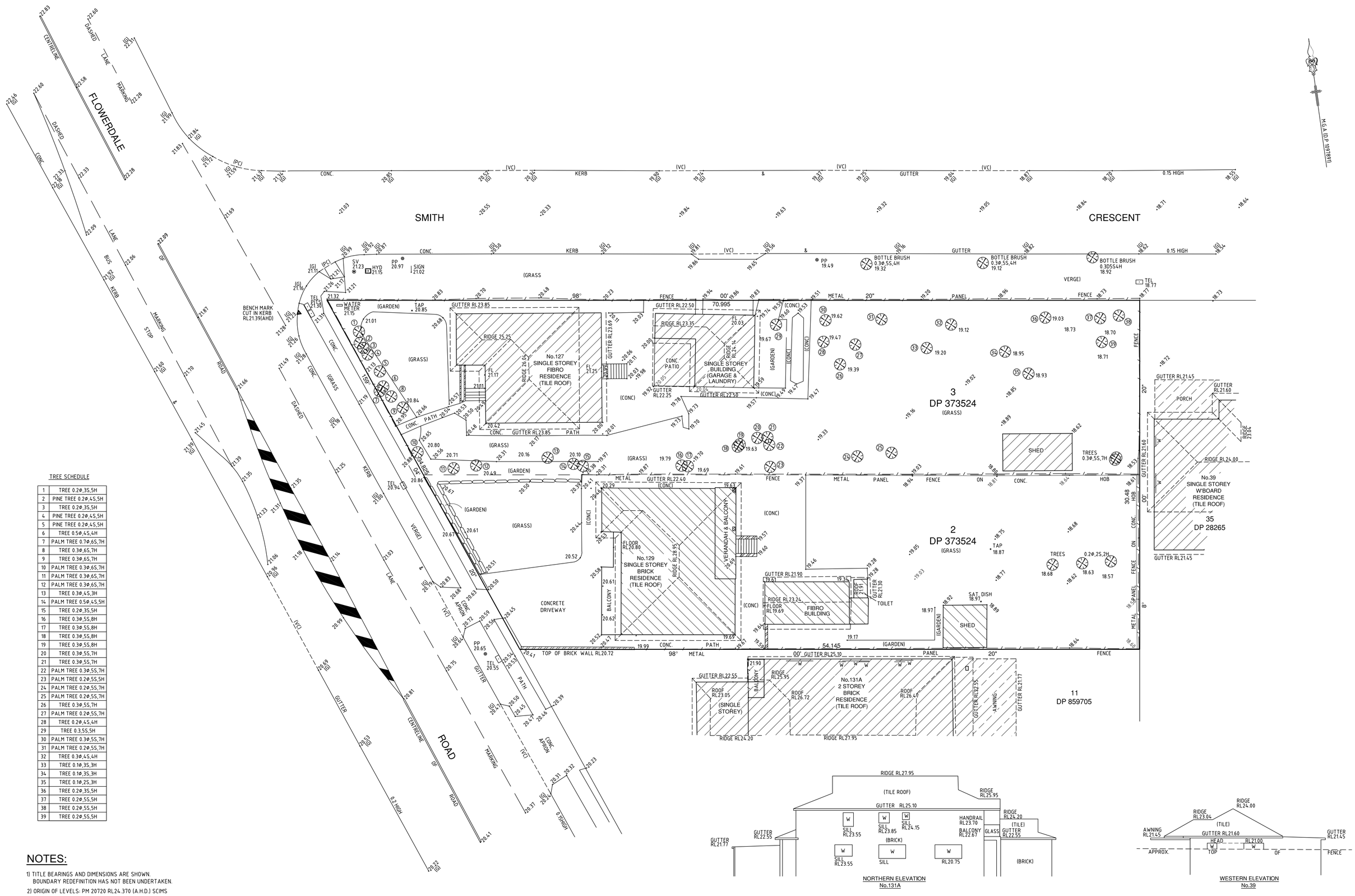

M.G.A (I.D.) 1917891

TREE SCHEDULE

1	TREE 0.2Φ,3S,5H
2	PINE TREE 0.2Φ,4S,5H
3	TREE 0.2Φ,3S,5H
4	PINE TREE 0.2Φ,4S,5H
5	PINE TREE 0.2Φ,4S,5H
6	TREE 0.5Φ,4S,4H
7	PALM TREE 0.7Φ,6S,7H
8	TREE 0.3Φ,6S,7H
9	TREE 0.3Φ,6S,7H
10	PALM TREE 0.3Φ,6S,7H
11	PALM TREE 0.3Φ,6S,7H
12	PALM TREE 0.3Φ,6S,7H
13	TREE 0.3Φ,4S,3H
14	PALM TREE 0.5Φ,4S,5H
15	TREE 0.2Φ,3S,5H
16	TREE 0.3Φ,5S,8H
17	TREE 0.3Φ,5S,8H
18	TREE 0.3Φ,5S,8H
19	TREE 0.3Φ,5S,8H
20	TREE 0.3Φ,5S,7H
21	TREE 0.3Φ,5S,7H
22	PALM TREE 0.3Φ,5S,7H
23	PALM TREE 0.2Φ,5S,5H
24	PALM TREE 0.2Φ,5S,7H
25	PALM TREE 0.2Φ,5S,7H
26	TREE 0.3Φ,5S,7H
27	PALM TREE 0.2Φ,5S,7H
28	TREE 0.2Φ,4S,4H
29	TREE 0.3,5S,5H
30	PALM TREE 0.3Φ,5S,7H
31	PALM TREE 0.2Φ,5S,7H
32	TREE 0.3Φ,4S,4H
33	TREE 0.1Φ,3S,3H
34	TREE 0.1Φ,3S,3H
35	TREE 0.1Φ,2S,3H
36	TREE 0.2Φ,3S,5H
37	TREE 0.2Φ,5S,5H
38	TREE 0.2Φ,5S,5H
39	TREE 0.2Φ,5S,5H

NOTES:

1) TITLE BEARINGS AND DIMENSIONS ARE SHOWN.
   BOUNDARY REDEFINITION HAS NOT BEEN UNDERTAKEN.
2) ORIGIN OF LEVELS: PM 20720 RL24.370 (A.H.D.) SCIMS
3) SITE COMPRISES LOTS 2 & 3 DP 373524
4) SITE AREA 1907.1 m^2 BY TITLE DIMENSIONS.
5) UNDERGROUND SERVICES HAVE NOT BEEN INVESTIGATED.
6) (G) DENOTES GUTTER LEVEL.
   0.3Φ10S,8H DENOTES TREE SIZE 0.3 TRUNK DIAMETER, 10 SPREAD, 8 HIGH.
7) TREE NAMES SHOWN CONSTITUTE OUR OPINION ONLY. IF TREE SPECIES IDENTIFICATION IS IMPORTANT FOR DESIGN OR HERITAGE REASONS THEY SHOULD BE DETERMINED BY A QUALIFIED ARBORIST.

ISSUE	DATE	AMENDMENT

TITLE: PLAN SHOWING SELECTED DETAIL & LEVELS OVER No.127-129 FLOWERDALE ROAD, LIVERPOOL

LGA: LIVERPOOL		REFERENCE: 24495	
CLIENT : ST GEORGE COMMUNITY HOUSING LTD.		DATE: 20.08.18	SHEET 1
SCALE (AT A1) 1:150	DATUM : AHD	SURVEYOR: MA	

Norton Survey Partners
SURVEYORS & LAND TITLE CONSULTANTS
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RESIDENTIAL DEVELOPMENT
AT 127-129 FLOWERDALE ROAD, LIVERPOOL

GENERAL

G1 These drawings shall be read in conjunction with all architectural and other consultants drawings and specifications and with such other written instructions and sketches as may be issued during the course of the Contract. Any discrepancies shall be referred to the Superintendent before proceeding with any related works. Construction from these drawings, and their associated consultant's drawings is not to commence until approved by the Local Authorities.

G2 All materials and workmanship shall be in accordance with the relevant and current Standards Australia codes and with the By-Laws and Ordinances of the relevant building authorities except where varied by the project specification.

G3 All set out dimensions shall be obtained from Architect's and Engineer's details. All discrepancies shall be referred to the Architect and Engineer for decision before proceeding with related work.

G4 During construction the structure shall be maintained in a stable condition and no part shall be overstressed. Temporary bracing shall be provided by the builder/subcontractor to keep the works and excavations stable at all times.

G5 Unless noted otherwise levels are in metres and dimensions are in millimetres.

G6 The alignment and level of all services shown are approximate only. The contractor shall confirm the position and level of all services prior to commencement of construction. Any damage to services shall be rectified at the contractors expense.

G7 Any substitution of materials shall be approved by the Engineer and included in any tender.

G8 All services, or conduits for servicing shall be installed prior to commencement of pavement construction.

G9 Subsoil drainage, comprising 100 agriculture pipe in geo-stocking to be placed as shown and as may be directed by the superintendent. Subsoil drainage shall be constructed in accordance with the relevant local authority construction specification.

G10 The structural components detailed on these drawings have been designed in accordance with the relevant Standards Australia codes and Local Government Ordinances for the following loadings. Refer to the Architectural drawings for proposed floor usage. Refer to drawings for live loads and superimposed dead loads.

DRAINAGE NOTES

D1 All drainage levels to be confirmed on site, prior to any construction commencing.

D2 All pipes within the property to be a minimum of 150 dia upvc @ 1% minimum grade, uno.

D3 All pits within the property are to be fitted with "weldlok" or approved equivalent grates:
- Light duty for landscaped areas
- Heavy duty where subjected to vehicular traffic

D4 All pits within the property to be constructed as one of the following;
1) Precast stormwater pits
2) Cast insitu mass concrete
3) Cement rendered 230mm brickwork subject to the relevant local authority construction specification.

D5 Ensure all grates to pits are set below finished surface level within the property. Top of pit RL's are approximate only and may be varied subject to approval of the engineer. All invert levels are to be achieved.

D6 Any pipes beneath relevant local authority road to be rubber ring jointed RCP, uno.

D7 All pits in roadways are to be fitted with heavy duty grates with locking bolts and continuous hinge.

D8 Provide step irons to stormwater pits greater than 1200 in depth.

D9 Trench back fill in roadways shall comprise sharp, clean granular back fill in accordance with the relevant local authority specification to non-trafficable areas to be compacted by rodding and tamping using a flat plate vibrator.

D10 Where a high early discharge (hed) pit is provided all pipes are to be connected to the hed pit, uno.

D11 Down pipes shall be a minimum of dn100 sw grade upvc or 100 x100 colorbond/zincalume steel, uno.

D12 Colorbond or zincalume steel box gutters shall be a minimum of 450 wide x 150 deep.

D13 Eaves gutters shall be a minimum of 125 wide x 100 deep (or of equivalent area) colorbond or zincalume steel, uno.

D14 Subsoil drainage shall be provided to all retaining walls & embankments, with the lines feeding into the stormwater drainage system, uno.

STRUCTURAL STEEL

SS1 All workmanship and materials shall be in accordance with AS 4100 except where varied by the contract documents.

SS2 Unless noted otherwise, all steel shall be in accordance with AS 3678 Grade 250 or AS 3679 Grade 300, or AS 1163 Grade 350 as appropriate.

SS3 Three (3) copies or 1 transparency of workshop drawings shall be submitted to the Engineer for review at least 7 days prior to commencement of fabrication. Fabrication shall not commence without Engineers approval of workshop drawings. All dimensions and setouts to be obtained from the Architects drawings where not indicated on the Structural drawings.

SS4 The bolting procedure is designated as follows: 4.6/S Commercial bolts of grade 4.6 to AS 1111 - snug tightened 8.8/S High strength bolts of grade 8.8 to AS 1252 - snug tightened 8.8/TB High strength bolts of grade 8.8 to AS 1252 fully tensioned to AS 4100 as a bearing type joint 8.8/TF High strength bolts of grade 8.8 to AS 1252 fully tensioned to AS 4100 as a friction type joint with facing surfaces left uncoated.

SS5 Unless noted otherwise all fillet welds shall be 6mm continuous category SP using E41XX electrodes. All butt welds shall be complete penetration butt welds SP to AS 1554.1, All gusset plates shall be 12 mm thick, all bolts shall be M20 8.8/S in 22mm diameter holes, minimum 2 bolts to each connection. All washers and bolts shall be galvanised.

SS6 Fabrication shall comply with AS 4100 - Section 14, Erection shall comply with AS 4100 - Section 15, /TB and /TF bolts to be installed in accordance with AS 4100 - Section 15, using either the part-turn method or the direct-tension indicator method.

SS8 Steelwork intending to be concrete encased shall be unpainted. Encasing concrete to be grade N25 providing cover adequate to suit fire rating or exposure conditions, Concrete encasement shall be centrally reinforced with 5mm wire to AS 1303 or 6mm structural grade bars to AS 1302 at 150mm pitch.

SS9 All steelwork below ground shall be encased by 75mm of concrete, steel wrapped with FGW41 placed 25mm clear of steel. Provide 50mm minimum encasing.

SS10 Steelwork not to be concrete encased shall be given one shop coat of an approved primer unless noted otherwise. Faces of friction grip connections shall not be painted. Refer to architectural specifications for coatings schedule.

SS11 The builder shall provide all cleats and drill all holes necessary for fixing steel to steel and timber and other elements to steel whether or not detailed in the drawings.

SS13 Provide seal plates to the plates to the ends of all hollow sections, with "breather' holes if members to be hot dip galvanised.

SS14 All steelwork shall be securely temporarily braced by the erector as necessary to stabilise the structure during erection. Design of all temporary bracing is the responsibility of the erector. Specific design details are to be forwarded onto the project engineer upon request.

SS15 All bolts shall be of such length that at least one full thread is exposed beyond the nut after the nut has been tightened.

SS16 Minimum one washer shall be used under the nut in all situations. If tightening is carried out at the head, and additional washer is to be used under the head. For slotted holes use hardened washer under the nut and bolt head.

SS17 Unless noted otherwise all material to be: Grade 250-Hot Rolled Plates, Flats, Angles (100 x 100 or 125 x 75 and smaller) Grade 300-All WB's and WC's Grade 300 Plus-All UB's, UC's, PFC's and larger angles. Grade 350-All RHS's, and CHS's

SS18 ALL steelwork to be hot dipped galvanised. Galvanising of structural steelwork to AS 1650. The continuous average zinc coating mass to be 600 g/m2 (550 g/m2 minimum)

SS19 The fabrication and erection of the structural steel work shall be supervised by a qualified engineer, experienced in such supervision, to ensure that all requirements of the design are met.

SS20 Surface finishes for all structural steelwork to be in accordance with the Architectural specification.

DESIGN CRITERIA

Site soil classification : ROCK
Site wind classification : TC 2.5
Earthquake design category: ED2
Construction type: FRAMED

FOUNDATION

F1 Refer to the notes on the foundation drawing for minimum allowable bearing capacity. The foundation material shall be approved by the Geotechnical Engineer for this bearing capacity before placing membrane, reinforcement or concrete,

F2 Refer to Geotechnical Report prepared by; Geotech Name NSW PUBLIC WORKS
Geotech Project No: -
Geotech Report No: 15-GS69A
Geotech Report Date: MAY 2015

Any additional investigation required by the contractor shall be at the contractor's expense.

F3 Footings shall be located centrally under walls/columns unless noted otherwise.

F4 Do not exceed a rise of 1 in a run of 2 for the line of slope between adjacent footings or excavations.

F5 Do not backfill retaining walls (other than cantilever walls) until floor construction at top and bottom is completed. Ensure free draining backfill and drainage is in place.

F6 Footings to be constructed and backfilled as soon as possible following excavation to avoid softening or drying out by exposure. Refer to drawings for backfill requirements.

REINFORCED CONCRETE

RC1 All workmanship and materials shall be in accordance with AS 3600 current edition with amendments, except where varied by the contract documents.

RC2 Readymix concrete supply shall comply with AS 1379.

RC3 Minimum concrete quality noted on relevant drawings, All the requirements of the ACSE Concrete Specification Document 1 (latest edition) shall apply to the formwork, reinforcement and concrete unless noted otherwise.

Compressive Strength,
Sample, test, and assess to AS 1379. All testing to be conducted by a NATA registered laboratory.

The minimum frequency of sampling of the concrete at each stage shall be in accordance with the following:

No of batches supplied:	No. of samples taken:
1	1
2 to 5	2
6 to 10	3
11 to 30	4
For Each additional 10 batches	1

A sample shall consist of four cylinders, two of which shall be tested at 28 days, one at 7 days and one at 4 days. If the contractor requires early strength results, additional cylinders shall be taken in the sample as required and at the cost of the contractor.
Other quality parameters
Sample: Test and assess to AS 1379 Section 5.
Slump: Test not less than one sample for each batch before placing concrete from that batch in the work. Take the samples at the point of discharge on site.
Drying Shrinkage: The maximum total drying shrinkage limit for the concrete shall be an average of 0.070% at 56 days and no single result shall exceed 0.075%. Measurement shall be in accordance with AS1012 Part 13 and be conducted by a NATA registered laboratory.
Rejection: Remove the concrete from the site.

RC4 No admixtures shall be used in concrete unless approved in writing.

RC5 Depth of beams are given first and include slab thicknesses. Slabs and beams shall be cast together unless noted otherwise.

RC6 Concrete sizes do not include thicknesses of applied finishes.

RC7 No holes, chases or embedments other than those shown on the drawings shall be made in concrete elements without the Project Engineers approval.

RC8 Concrete shall be kept free of supporting masonry with a pre-greased galvanised steel slip joint, vertical faces shall be separated by 10mm Jointex (or equal).

RC9 Construction joints shall be located to the satisfaction of the Project Engineer. The Builder shall allow for all necessary construction joints.

RC10 Conduits and pipes when cast in slabs or walls are to be placed between the reinforcement layers. Where there is only one layer of reinforcement, provide 50mm cover to conduit minimum.

RC11 Provide upward camber to formwork of reinforced concrete cantilevers of L/200 where L is the projection beyond column or wall face, and to formwork of slabs where noted on plans. Maintain slab and beam depths as shown. Provide 0mm precumber to post tensioned slabs U.N.O. on plans.

RC12 The finished concrete shall be a dense homogeneous mass, completely filling the formwork thoroughly embedding the reinforcement and free of stone pockets. All concrete including slabs on ground and footings shall be compacted with mechanical vibrators.

RC13 Slabs and beams shall be constructed to bear only on the beams, columns, walls etc. shown on the drawings. All other building elements shall be kept 12mm minimum clear from soffits of structure.

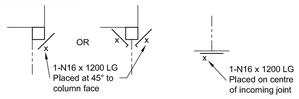
RC14 Curing of all concrete is to be achieved by keeping surfaces continuously wet for a period of 3 days, and prevention of loss of moisture for a total of 7 days followed by a gradual drying out. Approved sprayed on curing compounds that comply with AS 3799 may be used where floor finishes will not be affected, (refer Manufacturers Specification), Polythene sheeting or wet hessian may be used to retain moisture where protected from wind and traffic.

RC15 Construction support propping is to be left in place where needed to avoid overstressing the structure due to construction loading. No brickwork or partition walls are to be constructed on suspended levels until all propping is removed and the slab has absorbed its dead load deflection..

SLABS ON GRADE

SOG1 All re-entrant corners at penetrations for sumps, pits, column blockouts and the like, to have N16 trimmer bars place at 45 degrees to corner or in each direction at corners unless noted in a different arrangement on plan.

TRIMMER BARS IN SLAB:



Trimmer bars to be tied to U/S of slab mesh.

Provide sub-floor drainage to hydraulic engineers details.

Prior to placement of slab, subgrade shall be compacted to a minimum of 98% standard compaction in accordance with test 'E1.1' of AS 1289 for the top 300mm. Any soft spots shall be removed and replaced with site won material to the engineers approval.

REINFORCEMENT

R1 Minimum clear concrete cover to reinforcement including ties and stirrups shall be as follows uno.

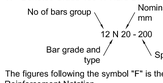
Exposure Classification	Minimum Cover (mm)				
	Concrete Strength (f'c)				
	20 MPa	25 MPa	32 MPa	40 MPa	> 50 MPa
A1	20	20	20	20	20
A2	(50)	30	25	20	20
B1	-	(60)	40	30	25
B2	-	-	(65)	45	35
C	-	-	-	(70)	50

R2 All reinforcement shall be firmly supported on mild steel plastic tipped chairs, plastic chairs or concrete chairs at not more than 1 metre centre both ways, Bars shall be tied at alternate intersections, In exposure conditions greater than B1 use only plastic chairs,

R3 The Engineer shall be given 24 hours notice for reinforcement inspection.

R4 Reinforcement is shown diagrammatically and is not necessarily in true projection. Splices to reinforcement shall be made only at the locations shown, or otherwise approved by the Project Engineer.

R5 Reinforcement Symbols:
S - Denotes Grade 230 S Hot Rolled Deformed Bars to AS 1302
Y - Denotes Grade 410 Y Bars to AS 1302 Grade Y
N - Denotes Grade 500 N Bars to AS 1302
R - Denotes Grade 230 R Hot Rolled Plain Bars to AS 1302
F - Denotes Grade 450 F Hard-Drawn Wire Reinforcing Fabric to AS 1304
W - Denotes Grade 450 W Hard-Drawn Plain Wire to AS 1303



The figures following the symbol "F" is the reference no. for fabric to AS 1304.
Reinforcement Notation.
T - Denotes top reinforcement.
B - Denotes bottom reinforcement.
NF - Denotes near face.
FF - Denotes far face.
EF - Denotes each face.

R6 Laps in reinforcement shall be U.N.O.

	N12	N16	N20	N24	N28	N32
Top	600	800	1000	1200	1440	1600
All Other Bars	500	650	800	950	1150	1300

* - Denotes horizontal bars with 300mm or more concrete cast below.
Laps in Fabric shall be U.N.O.

Fabric cross rod to be located at cover distance from form edges.

R7 Slab reinforcement shall extend minimum 65mm onto masonry support walls and minimum 50 percent of bottom reinforcement to be cogged, to achieve anchorage at simply supported ends. Terminate all top bars with standard cogs at form edges,

R8 Site bending of deformed reinforcing bars shall be done without heating using mechanical bending tools,

R9 All pull out bars shall be tempcore bars or approved equivalent. Bending and re-bending of bars shall be carried out in accordance with AS3600, AS/NZS4671, the specifications and the reinforcement suppliers recommendations. Bars shall not be heated above 400 degrees without the engineers written approval. Thermal crayons shall be used to ensure compliance with this temperature limit.

R10 Welding of reinforcement shall not be permitted unless shown on the structural drawings or approved by the Project Engineer.

R11 Joggles to bars shall be 1 bar diameter over a length of 12 bar diameters.

R12 Distribution reinforcement and tying steel shall be N12-400 minimum for conventional slabs, or N12-1000 minimum for post tensioned slabs where necessary unless noted otherwise on plan. Lap with main bars 400mm U.N.O.

R13 Reinforcement crossing penetrations shall be displaced as necessary, no reinft shall be cut without the prior written approval of the Project Engineer.

EROSION AND SEDIMENT CONTROL NOTES

E1 These notes are to be read in conjunction with erosion and sediment control details in this drawing set.

E2 The contractor shall implement all soil erosion and sediment control measures as necessary and to the satisfaction of the relevant local authority prior to the commencement of and during construction. No disturbance to the site shall be permitted other than in the immediate area of the works and no material shall be removed from the site without the relevant local authority approval. All erosion and sediment control devices to be installed and maintained in accordance with standards outlined in nsw department of housing's "managing urban stormwater - soils and constructions".

E3 Place straw bales length wise in a row as parallel as possible to the site contours, uno. Bale ends to be tightly butted. Bales are to be placed so that straws are parallel to the row. Bales are to be placed 1.5m to 2m downslope from the toe of the disturbed batter, uno.

E4 Council approved filter fabric to be entrenched 150mm deep upslope towards disturbed surface. Fabric to be a minimum SF2000 or better. Fix fabric to posts with wire ties or as recomended with manufacturer's specifications. Fabric joints to have a minimum of 150mm overlap. Wire to be strung between posts with filter fabric overlap to prevent sagging.

E5 Stabalised entry/exit points to remain intact until finished driveway is complete. Construction of entry/exit points to be maintained and repaired as required so that it's function is not compromised. Construction of entry/exit point to be in accordance with the detail contained within this drawing set.

E6 All drainage pipe inlets to be capped until:
- downpipes connected
- pits constructed and protected with silt barrier

E6 Provide and maintain silt traps around all surface inlet pits until catchment is revegetated or paved.

E7 The contractor shall regularly maintain all erosion and sediment control devices and remove accumulated silt from such devices such that more than 60% of their capacity is lost. All the silt is to be placed outside the limit of works. The period for maintaining these devices shall be at least until all disturbed areas are revegetated and further as may be directed by the superintendent or council.

E8 The contractor shall implement dust control by regularly wetting down (but not saturating) disturbed area.

E9 Topsoil shall be stripped and stockpiled outside hazard areas such as drainage lines. This topsoil shall be respread later on areas to be revegetated and stabilised only, (i.e. all footpaths, batters, site regarding areas, basins and catchdrains), Topsoil shall not be respread on any other areas unless specifically instructed by the superintendent. If they are to remain for longer than one month stockpiles shall be protected from erosion by covering them with a mulch and hydroseeding and, if necessary, by locating banks or drains downstream of a stockpile to retard silt laden runoff.

E10 Lay 300 wide minimum turf strip on 100 topsoil behind all kerb and gutter with 1000 long returns every 6000 and around structures immediately after backfilling as per the relevant local authority specification.

E11 The contractor shall grass seed all disturbed areas with an approved mix as soon as practicable after completion of earthworks and regrading.

E12 Revegetate all trenches immediately upon completion of backfilling.

E13 When any devices are to be handed over to council they shall be in clean and stable condition.

STANDARD LINE TYPES AND SYMBOLS

PROPOSED KERB & GUTTER
EXISTING KERB & GUTTER
PROPOSED BELOW GROUND PIPELINE
PROPOSED SUSPENDED PIPELINE
EXISTING PIPELINE
SUBSOIL DRAINAGE LINE
PROPOSED KERB INLET PIT
EXISTING KERB INLET PIT
PROPOSED JUNCTION OR INLET PIT
EXISTING JUNCTION OR INLET PIT
DESIGN CENTRELINE
EXISTING EDGE OF BITUMEN
TELECOMUNICATION CONDUIT
GAS MAIN
WATER MAIN
SEWER MAIN
UNDERGROUND ELECTRICITY CABLES
PERMANENT MARK & S.S.M.
BENCH MARK, SURVEY STATION

STANDARD LINE TYPES AND SYMBOLS

OVERLAND FLOW PATH
GUTTER DRAINAGE DIRECTION
DP — DOWNPIPE
DP — DOWNPIPE WITH SIDE OVERFLOW
PERVIOUS (GRASSED) AREAS
× RL= ?? — EXISTING (PRE-DEVELOPMENT) RL
× RL= ?? — POST DEVELOPMENT RL
FALL — GRADED IMPERVIOUS AREA (ROOF, CONC SLABS ETC)
SEDIMENT FENCE
CROSSING PIPES
1 — NODE POINT

LEGEND

AHD	Australlian height datum	SS	Stainless steel
AG	Ag-pipe (Sub soil drainage)	SU	Box gutter sump
ARI	Average recurrence interval	TW	Top of wall
BG	Box Gutter	TWL	Top water level
BWL	Bottom water level	U/S	Underside of slab
CL	Cover level	VG	Vally gutter
CO	Clean out inspection opening	UNO	Unless noted otherwise
DCP	Discharge control pit		
DP	Down pipe		
DRP	Dropper pipe		
EBG	Existing box gutter		
EDP	Existing down pipe		
EEG	Existing eaves gutter		
EG	Eaves gutter		
FRC	Fiber reinforced concrete		
FW	Floor waste		
GD	Grated drain		
GSIP	Grated surface inlet pit		
HED	High early discharge		
HP	High point of gutter		
IL	Invert level		
IO	Inspection opening		
O/F	Overflow		
OSD	On-site detention		
PSD	Permissible site discharge		
P1	Pipe 1		
RCP	Reinforced concrete pipe		
RHS	Rectangular hollow section		
RL	Reduced level		
RRJ	Rubber ring joint		
RRT	Rainwater re-use tank		
RWH	Rain water head		
RWO	Rain water outlet		
SLAP	Sealed lid access pit		
SP	Spreader pipe		
SPR	Spreader		

SCHEDULE OF DRAWINGS

C00.01	GENERAL NOTES
C01.01	SEDIMENT AND EROSION CONTROL PLAN
C02.01	STORMWATER DRAINAGE PLAN
C02.02	STORMWATER CATCHMENT PLAN
C02.11	STORMWATER DRAINAGE PLAN DETAILS SHEET
C03.01	ROOF DRAINAGE SHEET

RECOMMENDED MAINTENANCE SCHEDULE

DISCHARGE CONTROL PIT (DCP)	FREQUENCY	RESPONSIBILITY	PROCEDURE
Inspect flap valve and remove any blockage.	Six monthly	Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.
Inspect screen and clean.	Six monthly	Owner	Revove grate and screen if required and clean it.
Inspect & remove any blockage of orifice.	Six monthly	Owner	Remove grate & screen to inspect orifice, see plan for location of dcp.
Inspect dcp sump & remove any sediment-sludge.	Six monthly	Owner	Remove grate and screen. Remove sediment/sludge build-up and check orifice and flap valve clear.
Inspect grate for damage or blockage.	Six monthly	Owner	Check both sides of grate for corrosion, (especially corners and welds) damage or blockage.
Inspect return pipe from storage and return any blockage.	Six monthly	Owner	Remove grate and screen. ventilate underground storage if present. open flap valve and remove any blockages in return line. Check for sludge/debris on upstream side of return line.
Inspect outlet pipe and remove any blockage.	Six monthly	Maintenance Contractor	Remove grate and screen, ventilate underground storage if present. Check orifice and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line.
Check fixing of step irons is secure.	Six monthly	Maintenance Contractor	Remove grate and ensure fixings secure prior to placing weight on step iron.
Inspect overflow weir & remove any blockage.	Six monthly	Maintenance Contractor	Remove grate and open cover to ventillate underground storage if present. ensure weir clear of blockages.
Empty basket at overflow weir (if present),	Six monthly	Maintenance Contractor	Remove grate and ventilate underground storage chamber if present. Empty basket, check fixings secure and not corroded.
Check attachment of orifice plate to wall of pit (gaps less than 5 mm),	Annually	Maintenance Contractor	Remove grate and screen. ensure plate mounted securely, tighten fixings if required. seal gaps as required.
Check attachment of screen to wall of pit.	Annually	Maintenance Contractor	Remove grate and screen. ensure screen fixings secure. repair as required.
Check screen for corrosion.	Annually	Maintenance Contractor	Remove grate and examine screen for rust or corrosion, especially at corners or welds.
Check attachment of flap valve to wall of .	Annually	Maintenance Contractor	Remove grate. Ensure fixings of valve are secure.
Check flap valve seals against wall of pit.	Annually	Maintenance Contractor	Remove grate. fill pit with water and check that flap seals against side of pit with minimal leakage.
Check any hinges of flap valve move freely.	Annually	Maintenance Contractor	Remove grate. Test valve hinge by moving flap to full extent.
Inspect dcp walls (internal and external, if appropriate) for cracks or spalling.	Annually	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Check step irons for corrosion.	Annually	Maintenance Contractor	Remove grate. Examine step irons and repair any corrosion or damage.
Check orifice diameter correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see work-as- executed) and ensure edge is not pitted or damaged.
STORAGE			
Inspect & remove any blockage of orifice.	Six monthly	Owner	Remove grate and screen. remove sediment/sludge build-up.
Check orifice diameter correct and retains sharp edge.	Six monthly	Owner	Remove blockages from grate and check if pit blocked.
Inspect screen and clean.	Six monthly	Owner	Remove debris and floatable material likely to be carried to grates.
Check attachment of orifice plate to wall of pit (gaps less than 5 mm),	Annually	Maintenance	Remove grate to inspect internal walls, repair as required. clear vegetation from external walls if necessary and repair as required.
Check attachment of screen to wall of pit.	Five yearly	Maintenance Contractor	Compare actual storage available with work-as executed plans. If volume loss is greater than 5%, arrange for reconstruction to replace the volume lost. Council to be notified of the proposal.
Check attachment of screen to wall of pit.	Five yearly	Maintenance Contractor	Check along drainage lines and at pits for subsidence likely to indicate leakages.

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NOTE: DO NOT SCALE OFF DRAWINGS. REFER TO ARCHITECTURAL PLANS. VERIFY DIMENSIONS ON SITE

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RESIDENTIAL DEVELOPMENT
AT 127-129 FLOWERDALE ROAD, LIVERPOOL
FOR ST GEORGE COMMUNITY HOUSING

GENERAL NOTES

JOB NUMBER:	DWG NUMBER:	ORIGINAL SIZE:
18088	C00.01	A1
DESIGNED BY: RK	DATE: NOVEMBER 2018	
DRAWN BY: KRC	SCALE: N.T.S	

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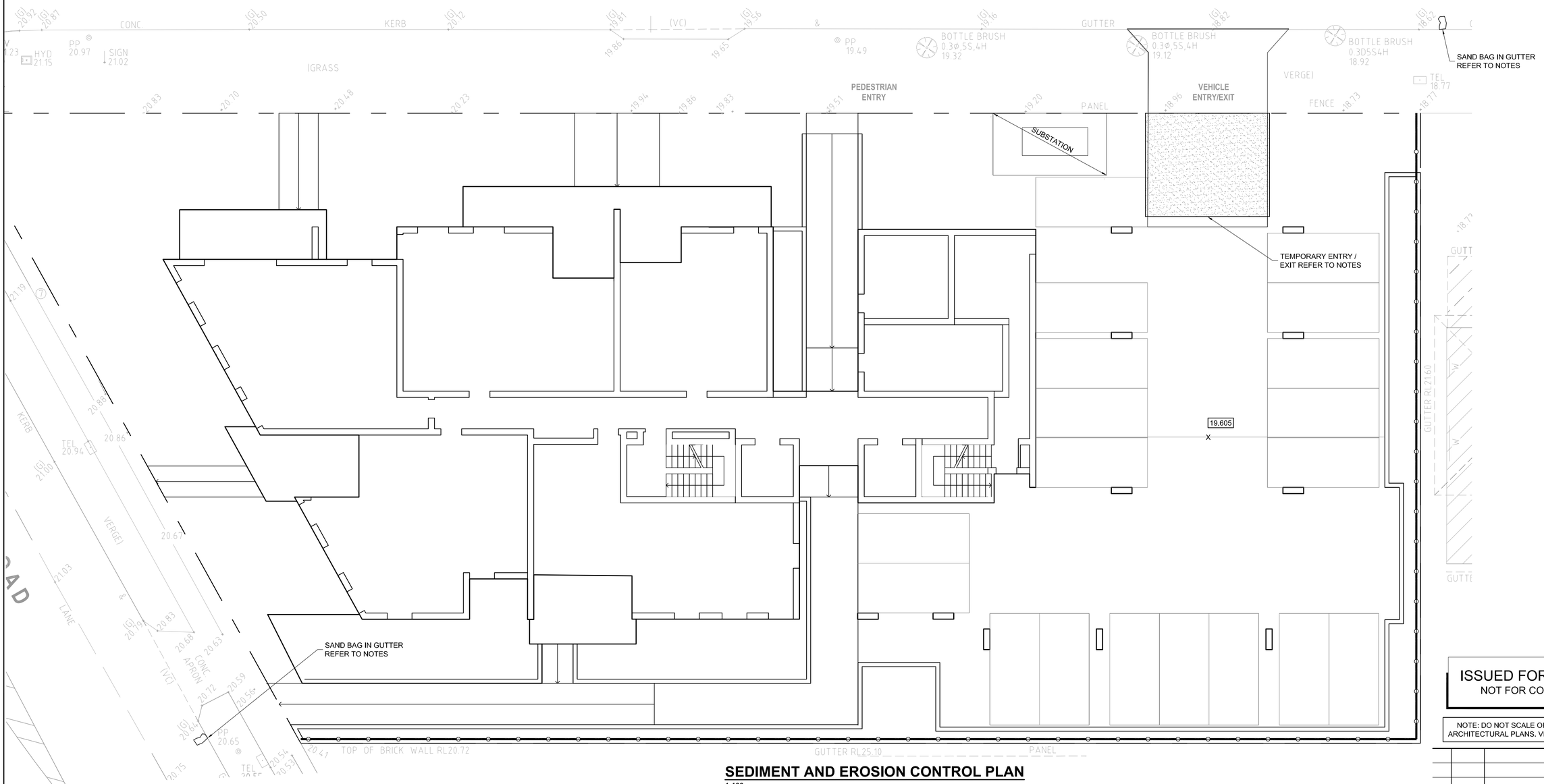


SEDIMENT AND EROSION CONTROL PLAN

1:100

GENERAL NOTES

THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER CONSULTANTS' DRAWINGS AND SPECIFICATIONS AND WITH OTHER SUCH WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.

ALL DIMENSIONS ARE IN MILLIMETRES & ALL LEVELS ARE IN METRES, U.N.O. (UNLESS NOTED OTHERWISE).

NO DIMENSION SHALL BE OBTAINED BY SCALING THE DRAWINGS.

ALL LEVELS AND SETTING OUT DIMENSIONS SHOWN ON THE DRAWINGS SHALL BE CHECKED ON SITE PRIOR TO THE COMMENCEMENT OF THE WORK.

DURING EXCAVATION WORK THE STRUCTURE SHALL BE MAINTAINED IN A STABLE AND NO PART SHALL BE OVERSTRESSED.

ALL WORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS & THE SPECIFICATION.

EXISTING SERVICES WHERE SHOWN HAVE BEEN PLOTTED FROM SUPPLIED DATA AND SUCH THEIR ACCURACY CAN NOT BE GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ESTABLISH THE LEVEL OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF WORK.

ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACK FILLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL COUNCIL.

ALL TRENCH BACK FILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.

ON COMPLETION OF STORMWATER INSTALLATION, ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL CONDITION, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AND GRASSED AREAS AND ROAD PAVEMENTS, UNLESS DIRECTED OTHERWISE.

CONTRACTOR TO OBTAIN ALL AUTHORITY APPROVALS UNLESS DIRECTED OTHERWISE.

SEDIMENT AND EROSION CONTROL NOTES

SEDIMENT AND EROSION CONTROL SHALL BE EFFECTIVELY MAINTAINED AT ALL TIMES DURING THE COURSE OF CONSTRUCTION AND SHALL NOT BE REMOVED UNTIL THE SITE HAS BEEN STABILISED OR LANDSCAPED TO THE SUPERINTENDENT'S SATISFACTION

A SINGLE ALL WEATHER ACCESS WAY WILL BE PROVIDED AT THE FRONT OF THE PROPERTY CONSISTING OF 50-75 AGGREGATE OR SIMILAR MATERIAL AT A MINIMUM THICKNESS OF 150 LAID OVER NEEDLE-PUNCHED GEOTEXTILE FABRIC AND CONSTRUCTED PRIOR TO COMMENCEMENT OF WORKS.

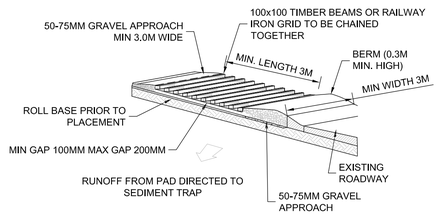
SOIL CONSERVATION NOTE

PRIOR TO COMMENCEMENT OF CONSTRUCTION PROVIDE 'SEDIMENT FENCE,' 'SEDIMENT TRAP' AND WASHOUT AREA TO ENSURE THE CAPTURE OF WATER BORNE MATERIAL GENERATED FROM THE SITE.

MAINTAIN THE ABOVE DURING THE COURSE OF CONSTRUCTION, AND CLEAR THE 'SEDIMENT TRAP AFTER EACH STORM.

TEMPORARY CONSTRUCTION ENTRY/EXIT

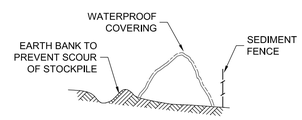
VEHICLE ACCESS TO THE BUILDING SITE SHOULD BE RESTRICTED TO A SINGLE POINT SO AS TO REDUCE THE AMOUNT OF SOIL DEPOSITED ON THE STREET PAVEMENT.



BUILDING MATERIAL STOCKPILE

ALL STOCKPILES OF BUILDING MATERIAL SUCH AS SAND AND SOIL MUST BE PROTECTED TO PREVENT SCOUR AND EROSION.

THEY SHOULD NEVER BE PLACED IN THE STREET GUTTER WHERE THEY WILL WASH AWAY WITH THE FIRST RAINSTORM.



STORMWATER DRAINAGE

THE STORMWATER DRAINAGE DESIGN HAS BEEN CARRIED OUT IN ACCORDANCE WITH
AS/NZS 3500.3 - 1990 "STORMWATER DRAINAGE" & AS/NZS 3500.3.2-1998 "STORMWATER DRAINAGE - ACCEPTABLE SOLUTIONS".

ANY VARIATIONS TO THE NOMINATED LEVELS SHALL BE REFERRED TO ENGINEER IMMEDIATELY.

ANY VARIATIONS TO SPECIFIED PRODUCTS OR DETAILS SHALL BE REFERRED TO THE ENGINEER FOR APPROVAL.

DOWN PIPES SHALL BE A MINIMUM OF DN100 SW GRADE uPVC OR 100 X 100 COLORBOND OR ZINCALUME STEEL, U.N.O.

BOX COLORBOND OR ZINCALUME STEEL. GUTTERS SHALL BE A MINIMUM OF 450 WIDE X 150 DEEP.

EAVES GUTTERS SHALL BE A MINIMUM OF 125 WIDE X 100 DEEP (OR OF EQUIVALENT AREA) COLORBOND OR ZINCALUME STEEL.

SUBSOIL DRAINAGE SHALL BE PROVIDED TO ALL RETAINING WALLS & EMBANKMENTS, WITH THE LINES FEEDING INTO THE STORMWATER DRAINAGE SYSTEM.

COMMENCEMENT OF WORKS

THE CONTRACTOR SHALL ENSURE THAT NO SPOIL OR FILL ENCROACHES UPON ADJACENT AREAS FOR THE DURATION OF WORKS.

THE CONTRACTOR SHALL ENSURE THAT KERB INLETS AND DRAINS RECEIVING STORMWATER SHALL BE PROTECTED AT ALL TIMES DURING DEVELOPMENT. KERB INLET SEDIMENT TRAPS SHALL BE INSTALLED ALONG THE IMMEDIATE VICINITY ALONG THE STREET FRONTAGE.

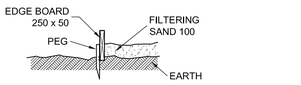
SEDIMENT FENCING SHALL BE SECURED BY POST (WHERE METAL STAR PICKETS ARE USED PLASTIC SAFETY CAPS SHALL BE USED) AT 2000 INTERVALS WITH GEOTEXTILE FABRIC EMBEDDED 200 IN SOIL.

ALL TOPSOIL STRIPPED FORM THE SITE AND STOCKPILED DOES NOT INTERFERE WITH DRAINAGE LINES AND STORMWATER INLETS AND WILL BE SUITABLY COVERED WITH AN IMPERVIOUS MEMBRANE MATERIAL AND SCREENED BY SEDIMENT FENCING.

SEDIMENT TRAP

1000 x 1000 WIDE 500 DEEP PIT, LOCATED AT THE LOWEST POINT TO THE TRAP SEDIMENT.

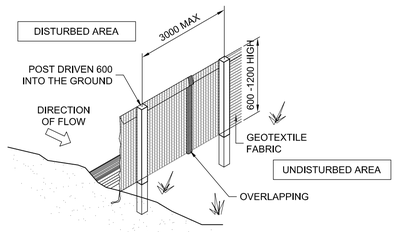
WASHOUT AREA TO BE 1800 x 1800 ALLOCATED FOR THE WASHING OF TOOL & EQUIPMENT.



SEDIMENT FENCE

PROVIDE 'SEDIMENT FENCE ON DOWN SLOPE BOUNDARY AS SHOWN ON PLAN.

FABRIC TO BE BURIED BELOW GROUND AT LOWER EDGE.



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SEDIMENT AND EROSION CONTROL PLAN

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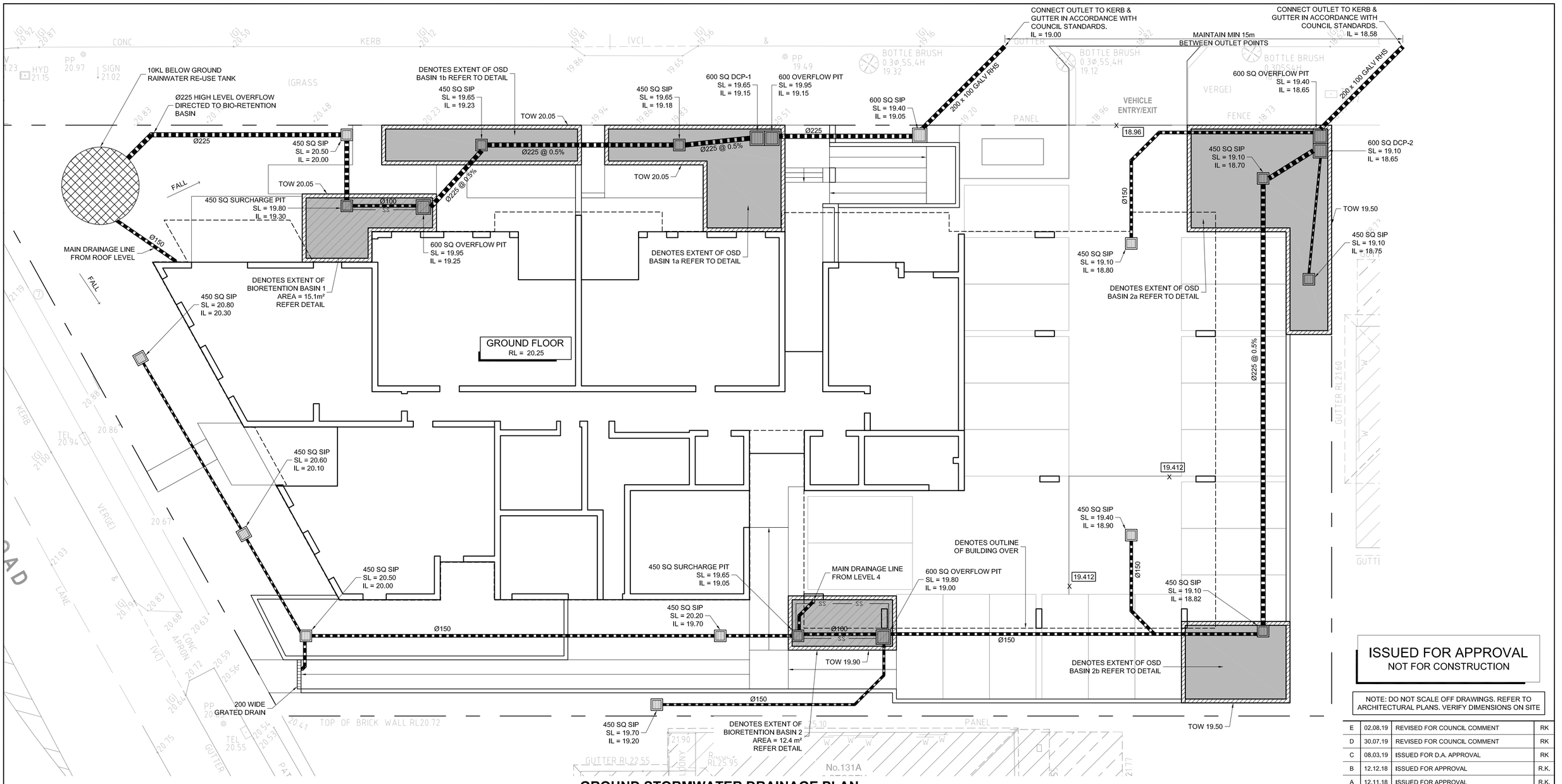
DESIGNED BY: RK	DATE: NOVEMBER 2018	
DRAWN BY: KRC	SCALE: N.T.S	



GROUND STORMWATER DRAINAGE PLAN

1:100

LEGEND:

RWO	DENOTES SPS Ø260 TRU-FLO RAINWATER OUTLET WITH Ø100 DOWN PIPE, TYPICAL
BO	DENOTES SPS 200 SQ PUSH IN FLOOR DRAIN WITH Ø80 DOWN PIPE, TYPICAL
PD	DENOTES 300 SQ SURFACE INLET PIT WITHIN PLANTER BOX, Ø100 DROPPER PIPE TO SUB-SOIL DRAINAGE BELOW
OF	DENOTES 200 x 50 STAINLESS STEEL OVERFLOW DUCT. DUCT INVERT TO BE 50mm ABOVE SLAB LEVEL
SDO	DENOTES SPOON DRAIN OUT IN 150w x 50d SPOON DRAIN REFER TO DETAIL
DP	DENOTES Ø100 DOWN PIPE U.N.O
(u)	DENOTES OBJECT UNDER
(o)	DENOTES OBJECT OVER
(s)	DENOTES SUSPENDED PIPE
	DENOTES IN GROUND STORMWATER DRAINAGE PIPE
SS	DENOTES Ø100 SUB-SOIL DRAINAGE PIPE
	DENOTES SURFACE INLET PIT AS NOTED ON PLAN

STORMWATER DRAINAGE NOTES:

1. ALL DRAINAGE LINES SHALL BE uPVC (CLASS SH) STORMWATER DRAINAGE PIPES U.N.O
2. ALL DRAINAGE LINES TO BE LAID AT 1% FALL MINIMUM U.N.O
3. FIRST FLUSH DEVICES MUST BE FITTED TO DRAINAGE LINES DISCHARGING TO A RAINWATER TANK TO BUILDERS DETAIL
4. MINIMUM SLOPE OF EXTERNAL CONCRETE SLABS ARE PREFERABLY 1.5% AND AN ABSOLUTE MINIMUM OF 1%.
5. ALL PITS TO BE FITTED WITH STORMWATER 360 ENVIROPODS TO MANUFACTURERS SPECIFICATIONS
6. ALL SERVICES LOCATIONS, EXTENTS AND DETAILS TO BE CONFIRMED PRIOR TO CONSTRUCTION.
7. MINIMUM EAVES GUTTER CROSS SECTIONAL AREA = 5600mm²
8. MINIMUM EAVES GUTTER SLOPE = 1:500
9. MINIMUM BOX GUTTER SLOPE = 1:200

DRAINAGE DESIGN SUMMARY:

COUNCIL: LIVERPOOL CITY COUNCIL

100 Yr 5min STORM INTENSITY	= 205 mm/hr
20 Yr 5min STORM INTENSITY	= 159 mm/hr
TOTAL SITE AREA	= 1907 m²
TOTAL PROPOSED IMPERVIOUS AREA	= 1183 m²
TOTAL ROOF AREA	= 509 m²
RAINWATER RE-USE TANK PROVIDED	= 10 kL

100% ROOF AREA DERECTED TO RE-USE TANK

2 CONNECTION POINTS TO KERB PROPOSED.
DISCHARGE LIMTED TO 20 L/s. MINIMUM 15 m APART.

WSUD SUMMARY:

TREATMENT TRAIN MODEL DEVELOPED USING MUSIC.
REFER TO RESULTS SUMMARY TABLE ADJACENT.

OSD SUMMARY:

OSD DESIGNED MODELLED USING DRAINS. MODEL PROVIDED UPON REQUEST.

POST DEVELOPMENT DISCHAGE LIMITED TO PRE DEVELOPMENT.
REFER TO FLOW SUMMARY TABLE ADJACENT.

SITE SPLIT INTO TWO MAIN CATCHMENTS WITH TWO OSD SYSTEMS OPERATING INDEPENDENTLY.

TOTAL SITE AREA DRAINING TO OSD BASIN = 1690.1m² (88.6%)
REFER TO CATCHMENT PLAN

OSD BASIN 1
AREA DRAINING TO OSD BASIN 1 = 736.9m²
STORAGE REQUIRED IN BASIN 1 = 10.18m³
20% INCREASE FOR VEGETATED BASIN = 12.22m³

VOLUME PROVIDED IN BASIN 1a = 7.78m³
VOLUME PROVIDED IN BASIN 1b = 4.56m³
TOTAL VOLUME PROVIDED IN BASIN 1 = 12.34

MAXIMUM HEAD TO ORIFICE CENTRELINE = 0.75m
ORIFICE SIZE TO DCP-1 = 100mm

OSD BASIN 2
AREA DRAINING TO OSD BASIN 2 = 953.4m²
STORAGE REQUIRED IN BASIN 2 = 15.18m³
20% INCREASE FOR VEGETATED BASIN = 18.22m³

VOLUME PROVIDED BASIN 2a = 12.96m³
VOLUME PROVIDED IN BASIN 2b = 5.54m³
TOTAL VOLUME PROVIDED IN BASIN 2 = 18.5m³

MAXIMUM HEAD TO ORIFICE CENTRELINE = 0.7m
ORIFICE SIZE TO DCP-2 = 110mm

MUSIC MODEL TREATMENT TRAIN RESULTS

	SOURCES	RESIDUAL	REDUCTION	TARGET
FLOW (ML/yr)	1.80	1.43	20.6%	-
TOTAL SUSPENDED SOLIDS (kg/yr)	206	37.8	81.7 %	80
TOTAL PHOSPHOROUS (kg/yr)	0.415	0.213	48.8 %	45
TOTAL NITROGEN (kg/yr)	3.82	1.68	56.0%	45
TOTAL GROSS POLLUTANTS (kg/yr)	39.7	0	95.1%	90

DRAINS FLOWS SUMMARY

	5 YEAR ARI	10 YEAR ARI	20 YEAR ARI	100 YEAR ARI
PRE - DEVELOPMENT FLOW (l/s)	57	64	77	95
TOTAL POST DEVELOPMENT FLOW (l/s)	41	42	46	47
POST DEVELOPMENT SUB CATCHMENTS				
POST - DEVELOPMENT CATCHMENT 1 FLOW (l/s)	16	16	17	18
POST - DEVELOPMENT CATCHMENT 2 FLOW (l/s)	18	18	19	21
POST - DEVELOPMENT CATCHMENT 3 STREET BYPASS FLOW (l/s)	5	6	7	8
POST - DEVELOPMENT CATCHMENT 4 REAR BYPASS FLOW (l/s)	2	2	3	3

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RESIDENTIAL DEVELOPMENT
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STORMWATER DRAINAGE PLAN

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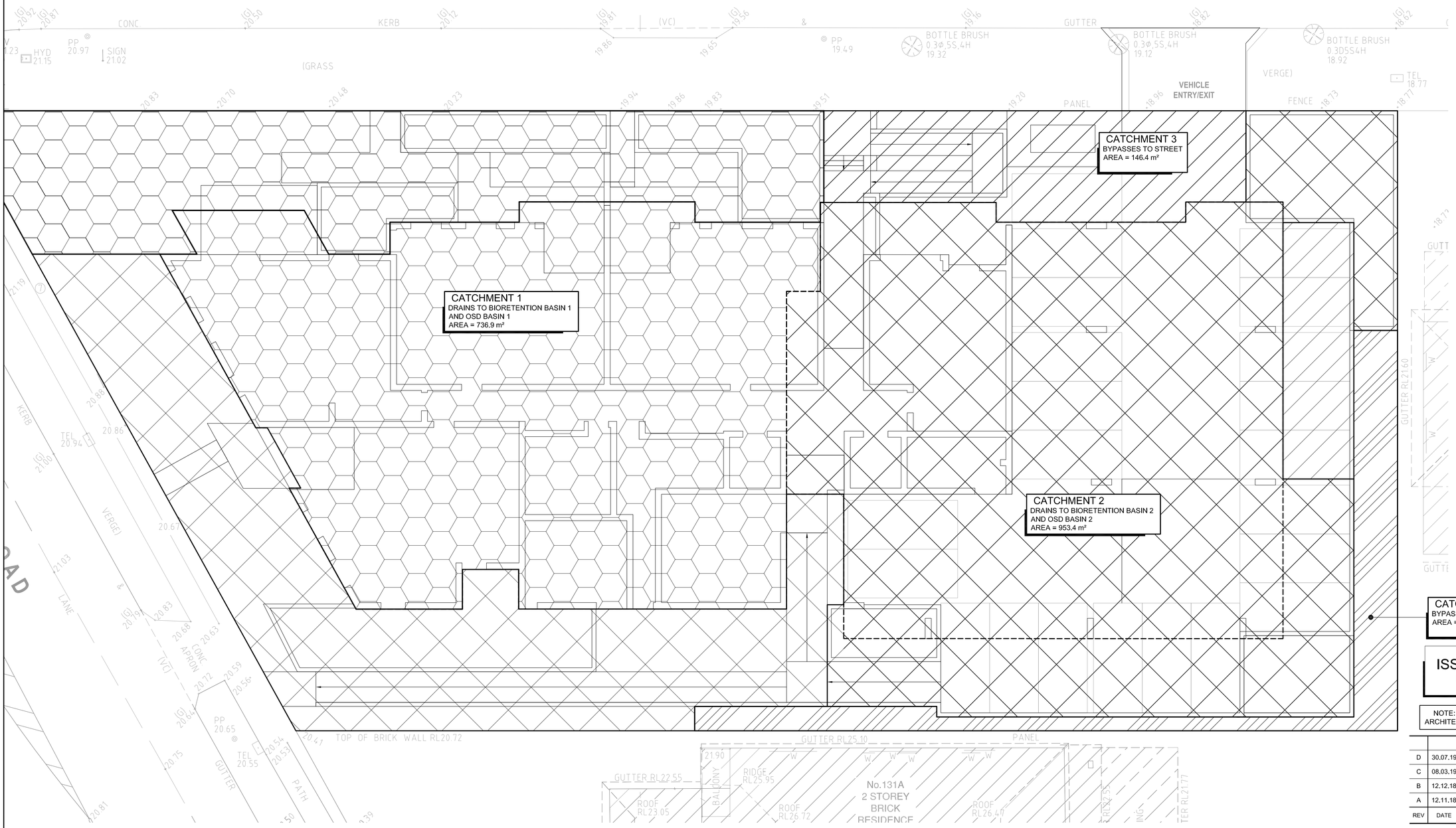
DESIGNED BY:	DATE:	
RK	NOVEMBER 2018	
DRAWN BY:	SCALE:	
KRC	1:100 U.N.O	



GROUND STORMWATER CATCHMENT PLAN

1:100

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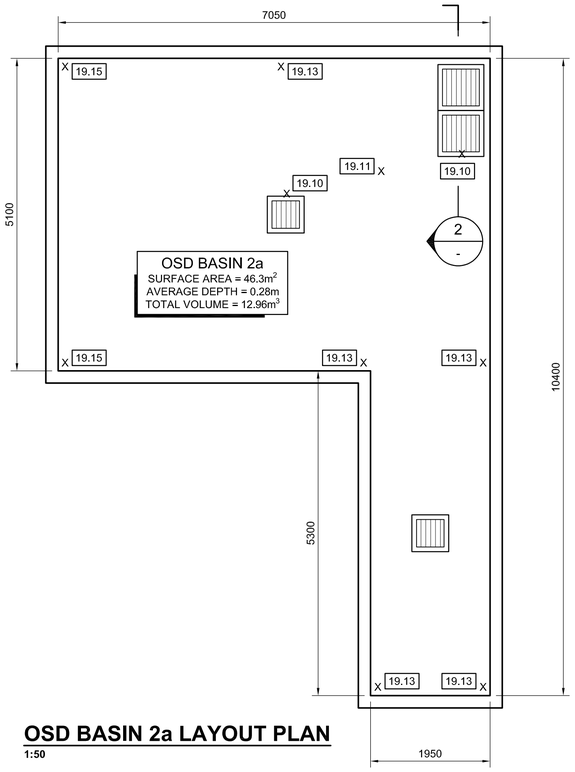
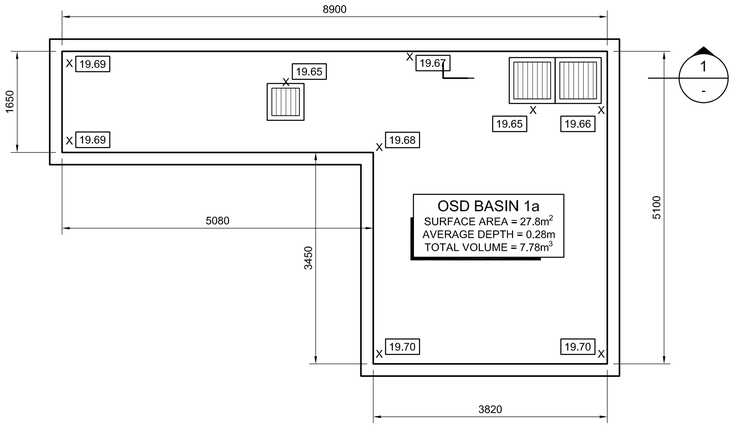
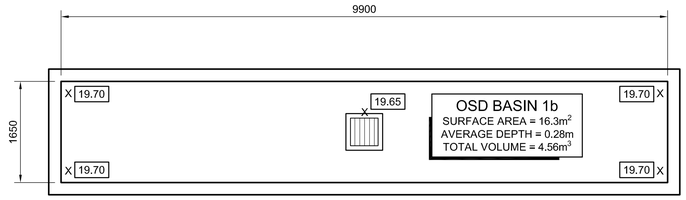
DESIGNED BY: RK	DATE: NOVEMBER 2018	
DRAWN BY: KRC	SCALE: 1:100 U.N.O	



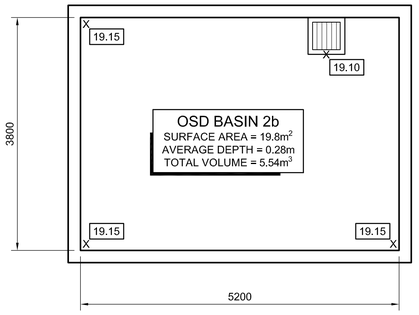
OSD BASIN 2a LAYOUT PLAN
1:50



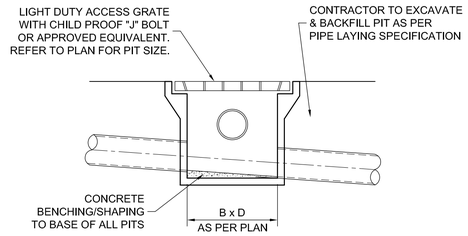
OSD BASIN 1a LAYOUT PLAN
1:50



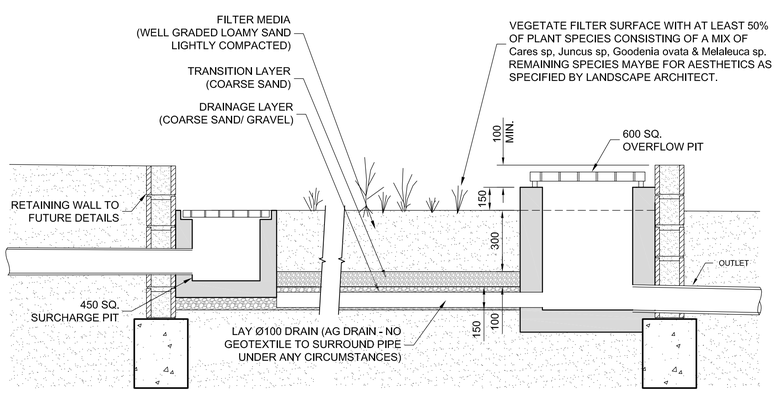
OSD BASIN 1b LAYOUT PLAN
1:50



OSD BASIN 2b LAYOUT PLAN
1:50



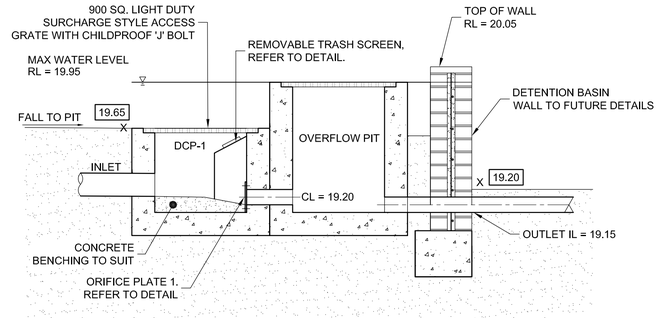
TYPICAL SURFACE INLET PIT DETAIL
1:20



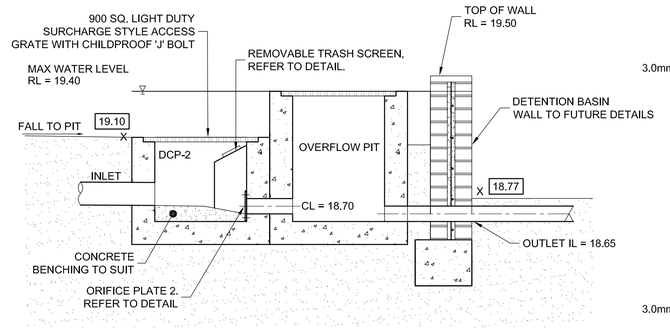
FILTER MEDIA SPECIFICATION
1. pH BETWEEN 5.5 TO 7.5
2. EC < 1.2 Ds/m
3. ORGANIC MATTER CONTENT < 5% W/W
4. PHOSPHORUS CONTENT < 100mg/kg
5. TOTAL SILT & CLAY CONTENT < 3% w/w
6. HYDRAULIC CONDUCTIVITY BETWEEN 100 & 300 mm/hr
7. NO MULCH TO BE APPLIED ON SURFACE

CONSTRUCTION NOTES:
1. MEDIA SPECIFICATION & GRADING TO BE VERIFIED BY HYDRAULIC ENGINEER PRIOR TO PLACEMENT.
2. FILTER MEDIA TO BE LIGHTLY COMPACTED USING A SINGLE PASS VIBRATING PLATE OR ROLLER (ETC. DRUM LAWN ROLLER).
3. FILTER MEDIA TO BE INSTALLED IN TWO LIFTS.
4. FILTER MEDIA SHALL HAVE A GEOTEXTILE PLACED OVER ITS SURFACE UNTIL RECEIVING CATCHMENT IS STABILISED (REFER TO SEDIMENT & EROSION CONTROL PLAN)
5. HYDRAULIC CONDUCTIVITY TO BE TESTED UPON COMPLETION OF THE FINAL STAGING OF WORKS.

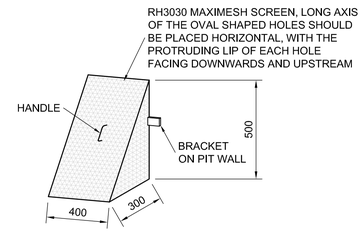
TYPICAL BIO-RETENTION BASIN DETAIL
1:20



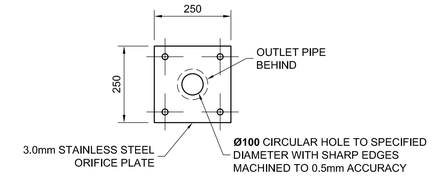
SECTION 1-1
1:20



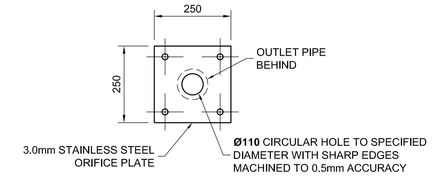
SECTION 2-2
1:20



STANDARD TRASH SCREEN
NTS



ORIFICE PLATE 1 DETAIL
1:10



ORIFICE PLATE 2 DETAIL
1:10

LEGEND
- PRESSURE VESSEL
- METER
- BALL VALVE RIGHT ANGLE TYPE
- DUAL CHECK VALVE
- PUMP
- GARDEN TAP
- DRINKING WATER SUPPLY PIPES
- RAINWATER SUPPLY PIPES
- DOWN PIPES

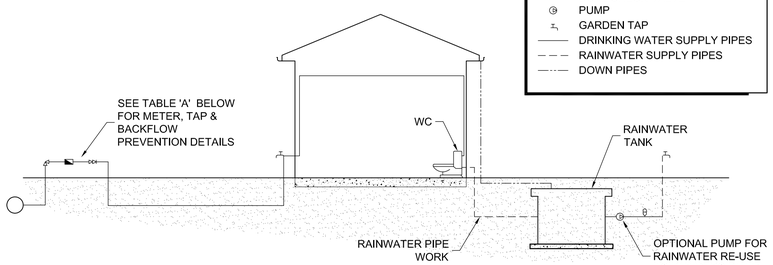


TABLE A

RAINWATER TANK LOCATION	METER SIZE (mm)	TYPE OF TAP	TYPE OF BACKFLOW PREVENTION
ABOVE GROUND	20	BALL VALVE	DUAL CHECK VALVE (COMBINED WITH METER)
	25	BALL VALVE	DUAL CHECK VALVE
	> 32	BALL VALVE	DUAL CHECK VALVE
BELOW GROUND	20	BALL VALVE	TESTABLE DOUBLE CHECK VALVE
	25	BALL VALVE	TESTABLE DOUBLE CHECK VALVE
	> 32	BALL VALVE	TESTABLE DOUBLE CHECK VALVE

DIAGRAM NOTES:
1 DRAWING TO BE READ IN CONJUNCTION WITH SYDNEY WATER PLUMBING REQUIREMENTS
2 FOR TANKS 10,000 LITRES OR LESS, COUNCIL DEVELOPMENT CONSENT IS NOT REQUIRED, IF THEIR CONDITIONS FOR INSTALLATION ARE FOLLOWED.
3 FOR TANKS GREATER THAN 10,000 LITRES COUNCIL DEVELOPMENT CONSENT IS GENERALLY REQUIRED.
4 FOR TANKS MORE THAN 10,000 LITRES APPROVAL IS REQUIRED FOR BUILDING OVER SEWERS.
5 SYDNEY WATER'S APPROVAL IS REQUIRED FOR ANY TOP UP FROM DRINKING WATER SUPPLY, REGARDLESS OF TANK SIZE. NO DIRECT CONNECTION IS ALLOWED BETWEEN THE DRINKING WATER SUPPLY AND THE RAINWATER TANK SUPPLY.
6 RAINWATER PIPEWORK IS SHOWN ON THE DIAGRAM AS SUPPLYING INTERNAL AND EXTERNAL RAINWATER USES. CUSTOMERS MAY WANT ONE OR THE OTHER.
7 ANY DESIGNED ACCESS LID INTO RAINWATER RE-USE TANK IS TO HAVE A LOCKABLE LID. IF THE LID IS DESIGNED TO BE ACCESSED BY A MAINTENANCE PERSON, IT MUST BE AT LEAST 600 mm x 900 mm IN SIZE.

DUAL DRINKING WATER & RAINWATER SUPPLY DIAGRAM
N.T.S.

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

NOTE: DO NOT SCALE OFF DRAWINGS. REFER TO ARCHITECTURAL PLANS. VERIFY DIMENSIONS ON SITE

REV	DATE	DESCRIPTION	BY
D	30.07.19	REVISED FOR COUNCIL COMMENT	RK
C	08.03.19	ISSUED FOR D.A. APPROVAL	RK
B	12.12.18	ISSUED FOR APPROVAL	R.K.
A	12.11.18	ISSUED FOR APPROVAL	R.K.

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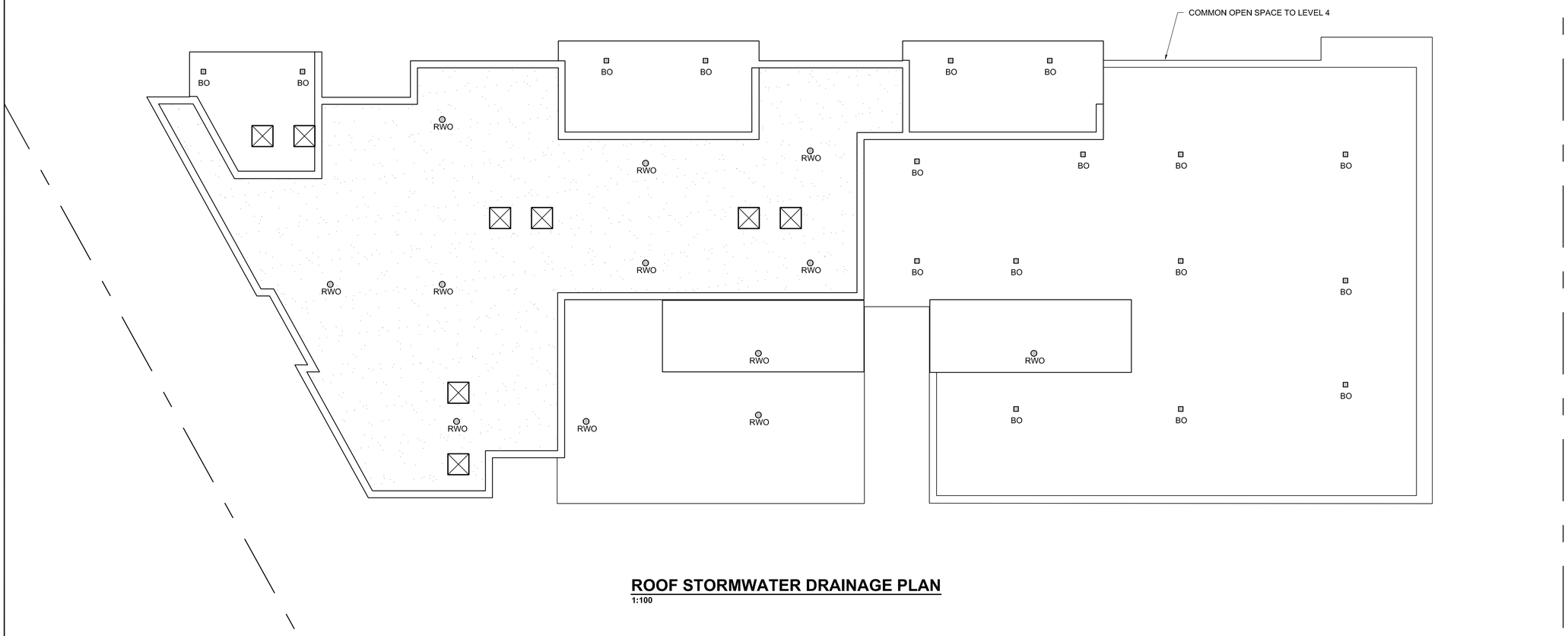
RESIDENTIAL DEVELOPMENT
AT 127-129 FLOWERDALE ROAD, LIVERPOOL
FOR ST GEORGE COMMUNITY HOUSING

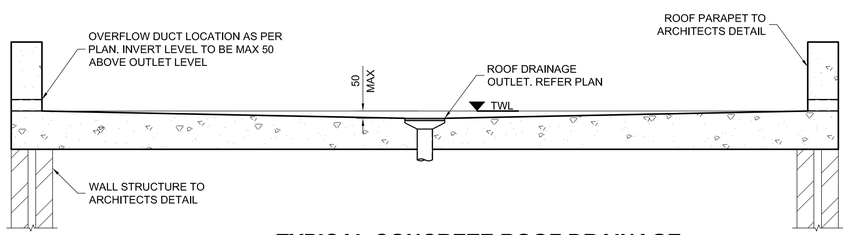
STORMWATER DRAINAGE DETAILS

JOB NUMBER:	DWG NUMBER:	ORIGINAL SIZE:
18088	C02.11	A1
DESIGNED BY: RK	DATE: NOVEMBER 2018	
DRAWN BY: KRC	SCALE: 1:100 U.N.O	



ROOF STORMWATER DRAINAGE PLAN
1:100

NOTE:
ROOF LEVEL DRAINAGE TO BE DIRECTED TO RAINWATER RE-USE TANK. COMMON OPEN SPACE DRAINAGE TO BE DIRECTED TO BIO-RETENTION BASINS. INTERMEDIATE LEVEL DRAINAGE TO BE DETAILED PRIOR TO C.C, SUBJECT TO COORDINATION WITH BUILDING CONSULTANTS



TYPICAL CONCRETE ROOF DRAINAGE
1:20

STORMWATER DRAINAGE NOTES:

1. ALL DRAINAGE LINES SHALL BE uPVC (CLASS SH) STORMWATER DRAINAGE PIPES U.N.O
2. ALL DRAINAGE LINES TO BE LAID AT 1% FALL MINIMUM U.N.O
3. FIRST FLUSH DEVICES MUST BE FITTED TO DRAINAGE LINES DISCHARGING TO A RAINWATER TANK TO BUILDERS DETAIL
4. MINIMUM SLOPE OF EXTERNAL CONCRETE SLABS ARE PREFERABLY 1.5% AND AN ABSOLUTE MINIMUM OF 1%.
5. ALL PITS TO BE FITTED WITH STORMWATER 360 ENVIROPODS TO MANUFACTURERS SPECIFICATIONS
6. ALL SERVICES LOCATIONS, EXTENTS AND DETAILS TO BE CONFIRMED PRIOR TO CONSTRUCTION.
7. MINIMUM EAVES GUTTER CROSS SECTIONAL AREA = 5600mm²
8. MINIMUM EAVES GUTTER SLOPE = 1:500
9. MINIMUM BOX GUTTER SLOPE = 1:200

LEGEND:

RWO	DENOTES SPS Ø260 TRU-FLO RAINWATER OUTLET WITH Ø100 DOWN PIPE, TYPICAL
BO	DENOTES SPS 200 SQ PUSH IN FLOOR DRAIN WITH Ø80 DOWN PIPE, TYPICAL
PD	DENOTES 300 SQ SURFACE INLET PIT WITHIN PLANTER BOX, Ø100 DROPPER PIPE TO SUB-SOIL DRAINAGE BELOW
OF	DENOTES 200 x 50 STAINLESS STEEL OVERFLOW DUCT. DUCT INVERT TO BE 50mm ABOVE SLAB LEVEL
SDO	DENOTES SPOON DRAIN OUT IN 150w x 50d SPOON DRAIN REFER TO DETAIL
DP	DENOTES Ø100 DOWN PIPE U.N.O
(u)	DENOTES OBJECT UNDER
(o)	DENOTES OBJECT OVER
(s)	DENOTES SUSPENDED PIPE
	DENOTES IN GROUND STORMWATER DRAINAGE PIPE
— ss — ss —	DENOTES Ø100 SUB-SOIL DRAINAGE PIPE
	DENOTES SURFACE INLET PIT AS NOTED ON PLAN

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

NOTE: DO NOT SCALE OFF DRAWINGS. REFER TO ARCHITECTURAL PLANS. VERIFY DIMENSIONS ON SITE

REV	DATE	DESCRIPTION	BY
B	12.12.18	REISSUED FOR APPROVAL	RK
A	12.11.18	ISSUED FOR APPROVAL	RK

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RESIDENTIAL DEVELOPMENT
AT 127-129 FLOWERDALE ROAD, LIVERPOOL
FOR ST GEORGE COMMUNITY HOUSING

ROOF STORMWATER DRAINAGE PLAN

JOB NUMBER:	DWG NUMBER:	ORIGINAL SIZE:
18088	C03.01	A1
DESIGNED BY: RK	DATE: NOVEMBER 2018	
DRAWN BY: KRC	SCALE: AS NOTED	

Y:\Projects\18088 - 127-129 Flowerdale Rd, Liverpool\Civil\C03.01 - Roof stormwater drainage plan.dwg 6:00 PM

abc CONSULTANTS
structural&civilengineers

Stormwater Management Concept Strategy

127 – 129 Flowerdale Road, Liverpool

St. George Community Housing

Report Number: 18088-SMCS
Date: August 2019
Revision: For Approval – E

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Document Control

Report Number: 18088-SMCS

Revision	Date	Author	Approved
For Approval – A	05 October 2018	Richard Khoury	Andrew Castle
Gateway 2.2 – B	12 November 2018	Richard Khoury	Andrew Castle
Gateway 2.2 – C	12 December 2018	Richard Khoury	Andrew Castle
Gateway 2.3 – D	12 December 2018	Richard Khoury	Andrew Castle
DA Submission – E	02 August 2019	Richard Khoury	Andrew Castle

Andrew Castle
Director

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Contents

1. Introduction

ABC Consultants has been engaged by St George Community Housing to complete the civil and structural engineering design for the proposed development at 127-129 Flowerdale Road, Liverpool.

The purpose of this report is to present a stormwater management concept for the proposed development. The report will demonstrate design compliance with local council guidelines, relevant Australian Standards, the SGCH Development and Construction Guidelines and other relevant authority requirements.

The proposed development is located within the Liverpool City Council municipality and as such is subject to controls outlined in the following documents:

- Liverpool Local Environmental Plan (LEP) 2008
- Liverpool Development Control Plan (DCP) 2008
- Liverpool City Council On-Site Stormwater Detention Technical Specification

In addition to the controls outlined in City of Sydney documents, the stormwater management design of the proposed development is based on and generally in accordance with AS/NZS 3500.3 – Australian/ New Zealand Standard: Plumbing and Stormwater, 2003 and the Institute of Engineers Australia, Australian Rainfall and Runoff (AR&R), 1997.

2. Project Description

The proposed development site is located at 127-129 Flowerdale Road, Liverpool. The site fronts Flowerdale Road to the West and Smith Crescent to the North. The site is bounded by residential properties in other directions.

The existing site two residential lots with single dwelling houses and some ancillary structures located on the properties. The total site area is 1907m^2. Refer to Appendix A for the existing site survey.

The proposed development is a 5-storey community housing facility with on site parking and open space amenities. Refer to Appendix B for a copy of the proposed architectural plans.

Figure 1 - Locality Map - Image courtesy of NSW Government SIX Maps

3. Design Approach

3.1. The Major-Minor System

The general design approach for all stormwater drainage within Australia is known as the major-minor system. The concept is discussed in detail in AR&R and a summary is provided below.

The minor system refers to the underground piped system and roof gutters capable of carrying runoff from minor storms. A minor storm is defined as a rainfall intensity with a 5% Annual Exceedance Probability (AEP) which is also referred to as a 20 year Annual Recurrence Interval (ARI) storm event. Refer to Appendix C for a full Intensity Frequency Table.

Design of the minor system is predicated on the control of regular occurring storms with the following objectives:

- The system has sufficient capacity to accept and convey storm water expected for all storms up to the 5% AEP
- The system does not require regular maintenance and when required, access to maintenance points is easily achievable.
- The structures and components associated with the minor system do not hinder the intended use of the area.

The major system refers to the overland flow paths which are to be designed to convey major storm flows when the capacity of the minor system is exceeded or when the minor system is blocked. Generally, the major system is sheet flow across the natural land slope however the system can be formalised with concrete or grass channels and swales. A major storm is defined as a rainfall intensity with an 1% AEP or a 100 year ARI.

The design of the major system is focused on the control of less frequent, more intense storms with the following objectives:

- The system has sufficient capacity to accept and covey stormwater expected for all storms up to the 1% AEP.
- The system maintains adequate free board to all habitable and internal building areas.
- Human safety is achieved in the design by limiting flow depth and flow velocity.

3.2. On-site Stormwater Detention

The peak run-off generated by a catchment is dependent on the storm intensity as well as the run-off coefficient. The run-off coefficient is a factor to account for the type of surface rainwater is contacting and flowing over. For example, rainwater falling on a forested area will generate a much smaller peak run-off compared to rainwater failing on a concreted area.

With urban development increasing the impervious area of a catchment, the peak run-off generated can be much higher and occur much quicker than a natural catchment. The result may be flash flooding with un-safe water depths and velocities.

In order to control the peak run-off generated by a site, water may be stored on site for a short period of time while being slowly released through a control mechanism. This method is known as On-site Stormwater Detention (OSD) and is common to most new developments. OSD typically consists of a storage tank or basin with water being discharged through a small hole in an orifice plate. The purpose of On-site Stormwater Detention is to limit the peak run-off of a developed catchment to that of the natural catchment.

Further to the above, local council drainage systems such as pits and pipes as well as formalised concrete channels may lack sufficient capacity to handle a minor storm event. In this case the council may impose stricter detention requirements to ensure regular flooding is prevented.

3.3. Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is a relatively new approach to water management in urban areas. The objective of WSUD is to maintain or replicate the pre-development water cycle through the use of design techniques to create a functionally equivalent hydrological landscape.

When urban development occurs, the natural water cycle is altered to the extent that stormwater runoff from individual properties and roads intensify, flows usually increase and potential contaminants from residential and commercial activity and associated vehicle use flow into the streams and watercourses.

Traditionally stormwater generated from urban areas is conveyed efficiently to designed trunk drainage systems to reduce stormwater ponding and flooding risk. The effect of this type of water management approach on natural systems has in the past included:

- the intensification of flows in watercourses potentially resulting in stream bank erosion and sedimentation;
- an increase in contamination of receiving aquatic environments resulting in generally adverse impacts on aquatic ecosystems;
- an increase in the use of water resources for domestic, commercial/industrial uses as well as outdoor irrigation of gardens and open space areas; and
- an increased tendency for more severe flooding and increased areas of flooding.

Much of the Sydney area has recently been converted from a peri-urban and rural land use to residential development. The implementation of WSUD in these areas can therefore be used to counteract disruptions to the natural water cycle.

4. Stormwater Management Strategy

4.1. Stormwater Design Documentation

A stormwater management concept plan has been prepared to demonstrate the integration of the civil engineering elements with the proposed architecture and other development constraints. Refer to Appendix C for a copy of the civil engineering plans.

4.2. Stormwater Connection Point

The proposed stormwater connection is two kerb outlets from the site to Smith Crescent spaced approximately 15m apart. There is no existing trunk drainage or council drainage assets within Smith Crescent or Flowerdale Road and as such a connection to the kerb and gutter is required.

Liverpool City Council's On-Site Stormwater Detention Technical Specification states '*Where the frontage of the development exceeds 24m, Council will consider a second outlet to the kerb and gutter provided that there is a minimum of 12m separation between the outlets and the discharge does not exceed 20 litres/second for the 1 in 10 year ARI and total post development flow off site do not exceed pre development flows.'*

In our opinion a second outlet to the kerb and gutter is justified as the total street frontage is 105m and the proposed outlets are separated by 15m. Further the proposed development site is a consolidation of two lots allowing one connection point per lot.

The site discharge to the kerb and gutter is controlled by the site OSD systems to ensure that the discharge at each connection point is limited to a maximum of 20 litres / second for the 1 in 10 year ARI and the total post development flow does not exceed the pre development flow.

On the advice of Liverpool City Council the discharge of 20 litres / second is to include all piped and overland flow water directed to Smith Crescent. As a result, the OSD permissible site discharge has been reduced to account bypass discharge rate.

4.3. Rainwater Re-use Tank

SGCH Development and Construction Design Guidelines requires that all new developments assessed under SEPP 65 must install a rainwater re-use tank. The tank must be located in an area where vehicle access is permitted for maintenance purposes and must be used for irrigation purposes only.

A 10kL below ground re-use tank is proposed in the North West corner of the site to collect all roof drainage. The tank is to be connected to the water supply system for irrigation purposes only. The rainwater tank is accessible from Smith Crescent for maintenance purposes.

4.4. OSD Design

The design criteria for On-site Stormwater Detention is provided by Liverpool City Council On-Site Stormwater Detention Technical Specification.

The above documents outlines the OSD storage and discharge requirements as '*The rate of stormwater runoff (both piped and overland) from the post-development site) for [all storm events up to the 100year ARI storm] must not exceed the pre-development run off'.*

A DRAINS Model has been prepared for the development to analyse the pre and post development conditions. Two OSD Basins are to be provided as part of the development (one for each connection point) and the discharge from each basin to the connection point must remain less than 20l/s in the 10year storm event as discussed above.

The site has been sub-divided into sub-catchments such that OSD Basin 1 accepts 736.9m^2 of site area and OSD Basin 2 accepts 953.4m^2 of site area. A total of 216.9m^2 of site area bypassed the OSD systems which represents 11.4% of total site area. Refer to the catchment map in the civil engineering documentation for details of the catchment extents.

The figures below show the general layout of the DRAINS models. A full copy of the DRAINS model has been provided as part of the DA Submission to Council.

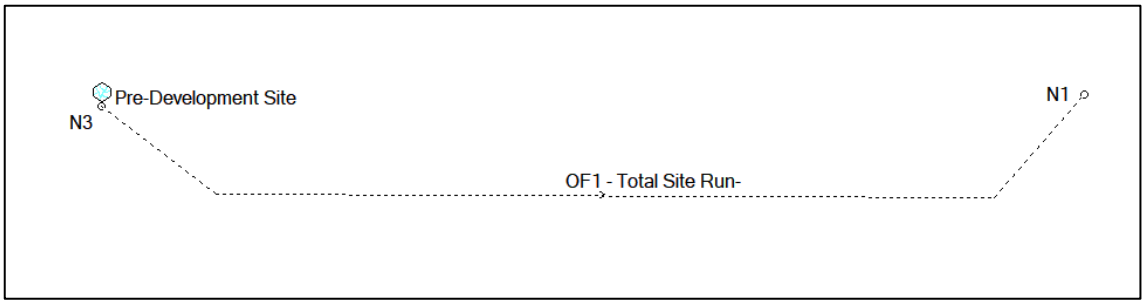

Figure 2 - General Arrangement of Pre-development Drains Model

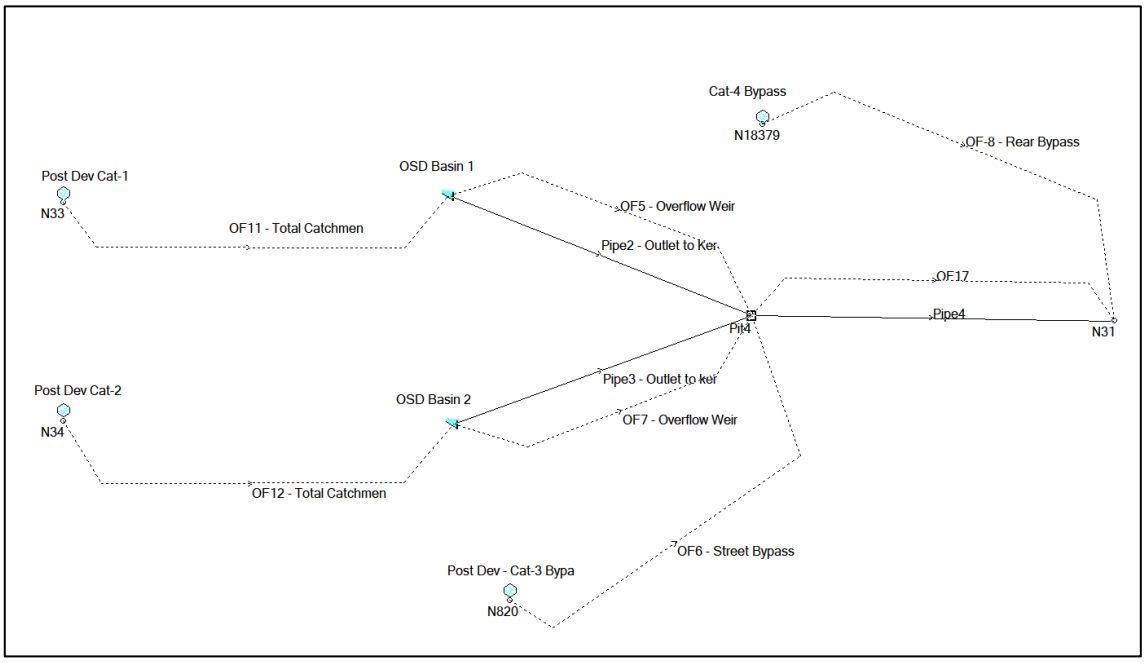

Figure 3 – General Arrangement of Post Development Drains Model

A flow summary of the DRAINS model shown above is represented in the table below. Full snapshots of the DRAINS outputs is shown in Appendix D.

Drains Flow Summary	5 Year ARI	10 Year ARI	20 Year ARI	100 Year ARI
Total Pre-development Flow (l/s)	57	64	77	95
Total Post Development Flow (l/s)	41	42	46	47
Total Flow to Smith Cres. (l/s)	39	40	43	44
Post Development – Catchment 1 OSD Basin 1 Outflow (l/s)	16	16	17	18
Post Development – Catchment 2 OSD Basin 2 Outflow (l/s)	18	18	19	21
Post Development – Catchment 3 Bypass to Smith Crescent (l/s)	5	6	7	8
Post Development – Catchment 4 Bypass to Rear (l/s)	2	2	3	3

Based on the site flow summarised above, DRAINS has calculated the storage required in each basin at the specified ARI intervals. The DRAINS output is summarised below.

OSD Basin 1 Storage	5 Year ARI	10 Year ARI	20 Year ARI	100Year ARI
Basin Inflow (l/s)	25	28	32	40
Basin Outflow (l/s)	16	16	17	18
Total Storage Required (m^3)	3.03	4.34	6.20	10.18
Vegetated Basin Storage (m^3)	3.63	5.2	7.44	12.22

OSD Basin 2 Storage	5 Year ARI	10 Year ARI	20 Year ARI	100Year ARI
Basin Inflow (l/s)	32	36	42	51
Basin Outflow (l/s)	18	18	19	21
Total Storage Required (m^3)	5.16	7.03	9.63	15.18
Vegetated Basin Storage (m^3)	6.19	8.44	11.56	18.22

Based on the above information, it can be shown that the total site discharge for the post development condition is less than the total site discharge in the pre development condition for all ARI intervals. Further, the total site area discharging to Smith Crescent in a 10 Year ARI is less than the required 20l/s per outlet.

The OSD Basins storage volume has been increased by 20% by the volume calculated by DRAINS to allow for a vegetated basin. A total volume of 12.34m^3 has been provided in OSD Basin 1 and a total volume of 18.5m^3 has been provided in OSD Basin 2.

4.5. Water Sensitive Urban Design

The general approach to Water Sensitive Urban Design (WSUD) is to achieve a pollutant reduction target for the post developed site. Liverpool Council's stormwater quality reduction targets are as listed Table 2.

A MUSIC model has been prepared to develop a treatment train for the development site. The MUSIC model was prepared in accordance with NSW MUSIC Modelling Guidelines and WSUD Technical Guidelines for Western Sydney.

The stormwater treatment system presented provides a series of treatment methods in order to avoid the potential end of line treatment option. The system aims to integrate with the site landscaping as best possible to encourage soil re-charge.

The proposed treatment train for the subject site involves the following treatment measures:

- Rainwater re-use tank – A 10kl rainwater re-use tank is proposed to collect all roof drainage and re-use the water for irrigation purposes.
- Enviropods – Stormwater 360 Envirpods are to be fitted throughout the site with a higher concentration of the gross pollutant filters in the ground floor areas unable to drain to the drainage swales.
- Bio-retention Basins – A total of 40m^2 of bio-retention basins vegetated with nutrient removal plants and a sandy loam filter media are proposed to stormwater from the development.
- OSD Basins – Above ground OSD basins are proposed to restrict the outflow of water which in turn provides a temporary pond for pollutants to settle. As the basins are located in deep soil areas, water infiltration will also occur providing further treatment.

See Figure 4 for a general arrangement of the MUSIC Model prepared for the subject development.

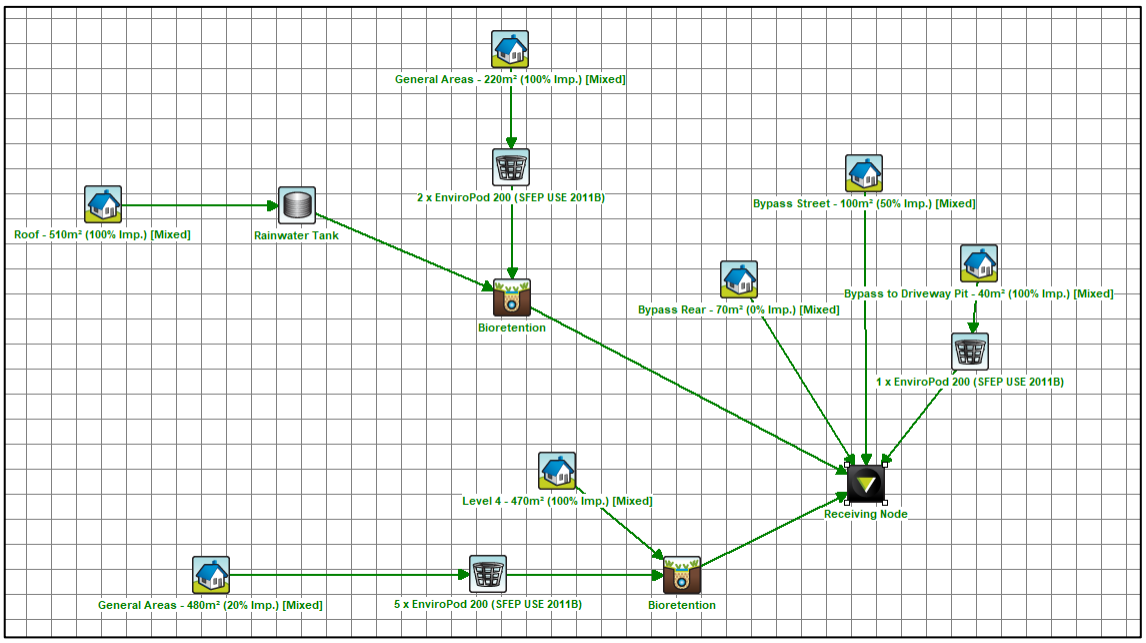

Figure 4 - MUSIC Model General Arrangement

Table 2 below details the treatment train effectiveness of the MUSIC model.

	Sources	Residual	Target	Achieved
Flow (ML/yr)	1.80	1.43	-	20.6%
Total Suspended Solids (kg/yr)	206	37.8	80%	81.7%
Total Phosphorus (kg/yr)	0.415	0.213	45%	48.8%
Total Nitrogen (kg/yr)	3.82	1.68	45%	56.0%
Total Gross Pollutants (kg/yr)	39.7	1.96	90%	95.1%

Table 1 - MUSIC Pollutants Output Summary

The above demonstrates that the pollutants generated from the post development site will be controlled with the treatment targets set by Council being achieved. The treatment train uses a combination of methods to capture and treat the different types of pollutants.

4.6. Rear Site Bypass

The subject site drains naturally in an easterly direction and slightly to the south. The south eastern corner is approximately 300mm lower than the north eastern corner.

The predevelopment condition is largely undeveloped grassed area with only 30% of the site either roofed or impervious. Approximately 1335m^2 of the pre-development site has no formal drainage system with water following the natural course onto neighbouring properties during a storm event.

The majority of the proposed development is able to drain to Smith Crescent at the north eastern corner. A small area of the site (70.5m^2) remains uncontrolled in the post development case. This area is directly adjacent to the south and east boundary fences. The area is to remain as per the pre-development condition, that is, all natural ground levels are to remain and the area will remain fully vegetated.

As a comparison of flow rates, the current pre-development condition discharges a total of 20.7l/s onto the neighbouring properties in a 5 year 5minute storm event (a rainfall intensity of 140mm/hr and run-off coefficient of 0.4 has been used for this calculation). In the post development condition, with the reduced area, the total discharge onto the neighbouring properties is reduced to 4.5l/s even in a 100 year 5minute storm event (a rainfall intensity of 230mm/hr and a run-off coefficient of 1.0 has been used for this calculation).

We would consider the proposed development advantageous to the downstream neighbouring properties as the formalised drainage system directs stormwater away from their properties and onto Smith Crescent. The water is discharged to Smith Crescent at a controlled rate so as not to overwhelm councils existing drainage network. The amount of site area which remains draining onto the neighbouring properties is considered negligible.

5. Conclusion

The stormwater management plan demonstrates that the stormwater drainage for the site has been designed in accordance with local council guidelines, relevant Australian Standards and the SGCH Development and Construction Guidelines

A minor pit and pipe drainage system has been detailed in ABC Consultant's design documentation to reduce the risk of nuisance flooding and control stormwater in events up to an including the 20 year storm event.

A major overland flow system has also been detailed to ensure the safe flow of water through the site.

On-site stormwater detention has been provided to control the peak discharge from the site and protect the local catchment from flooding.

A comprehensive treatment train has been developed to reflect the natural hydrology of the site and reduce pollutants to within an acceptable range. Drainage swales, above ground detention basins, a rainwater tank and Stormwater 360 Enviropod filter baskets have been included as part of the site treatment system

This stormwater management plan is to be read in conjunction with the ABC Consultants civil engineering concept plans. The report is presented to provide an understanding of the overall site stormwater drainage system.

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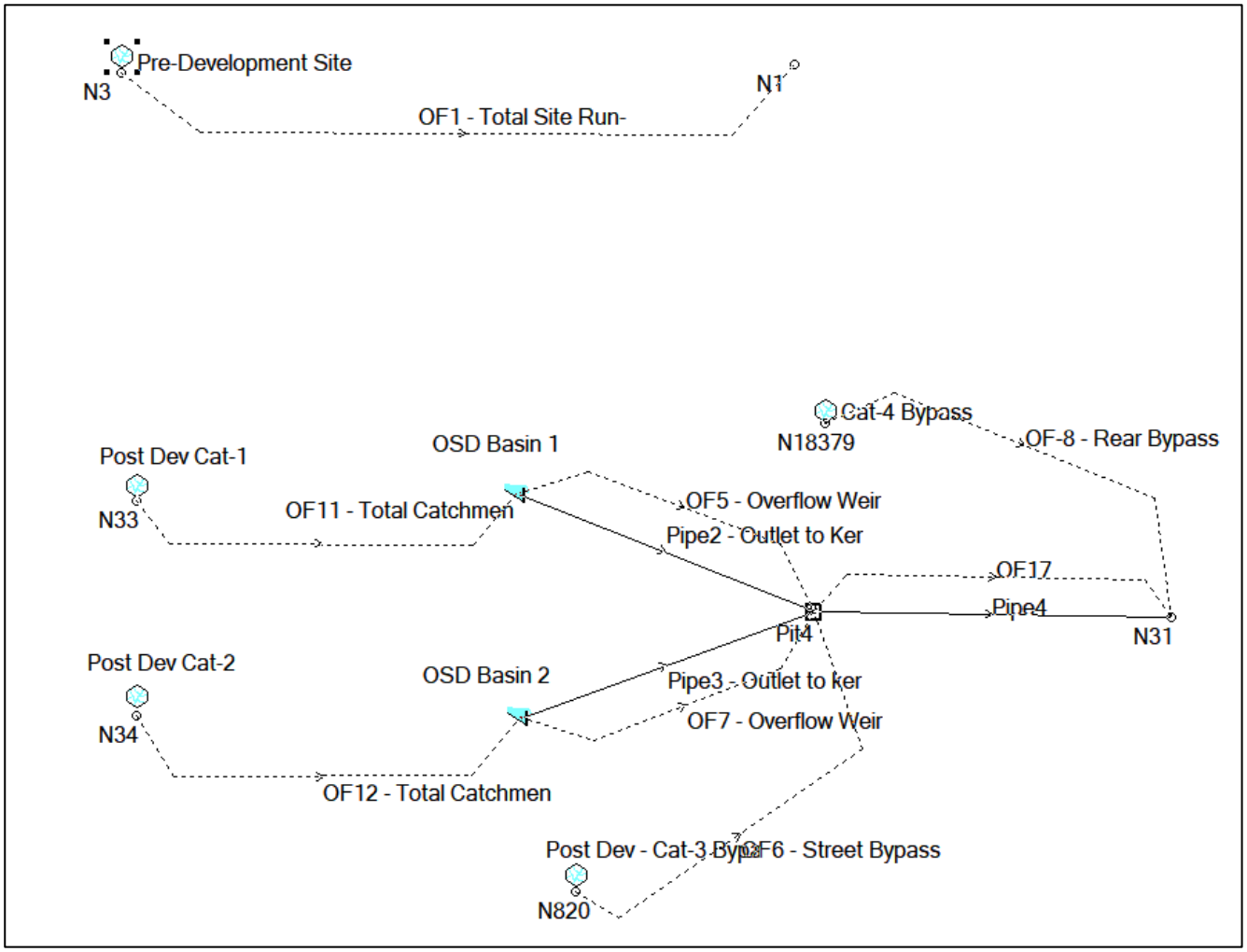
6. Appendix A – Existing Site Survey

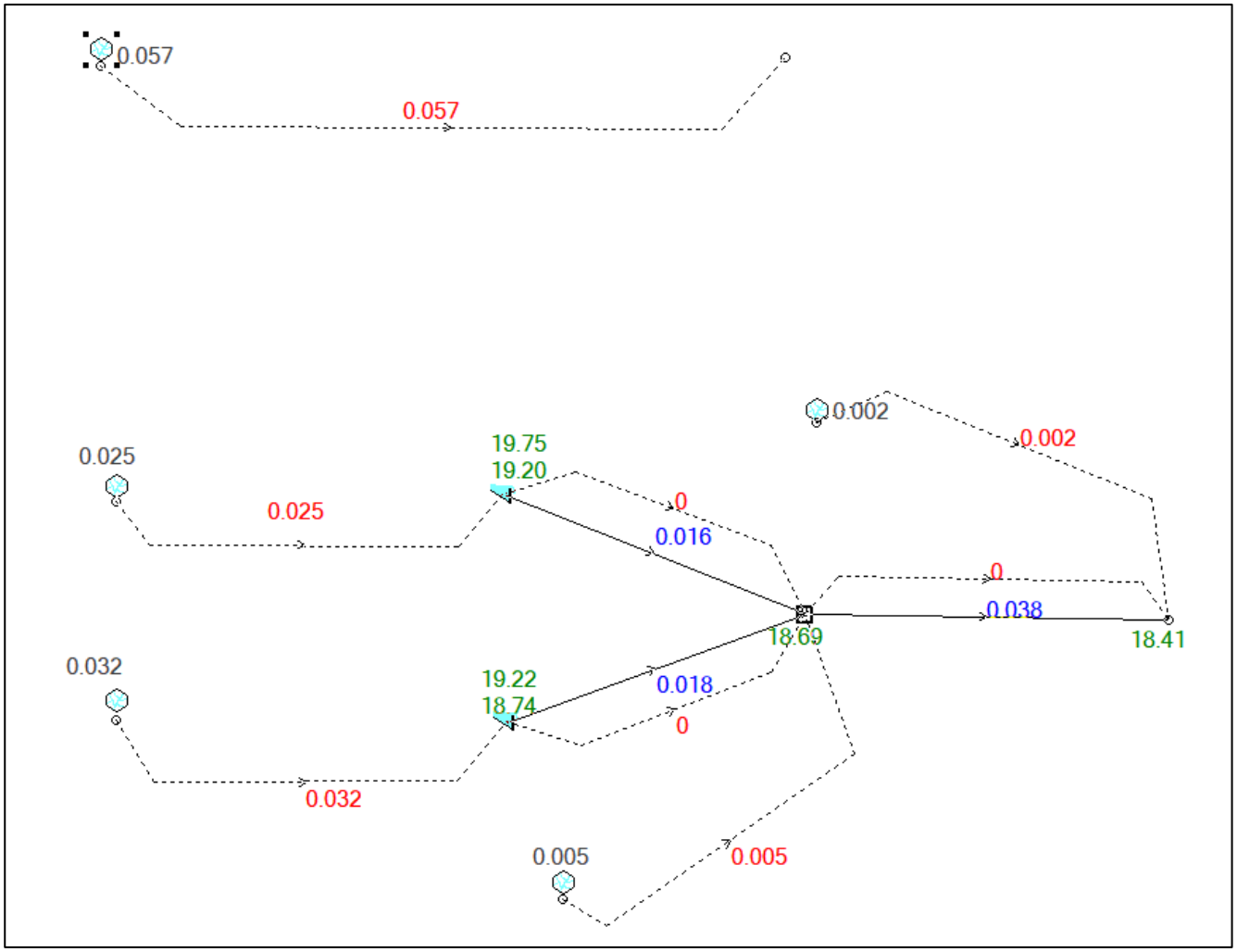
7. Appendix B – Proposed Architectural Plans

8. Appendix C – Proposed Civil Engineering Plans

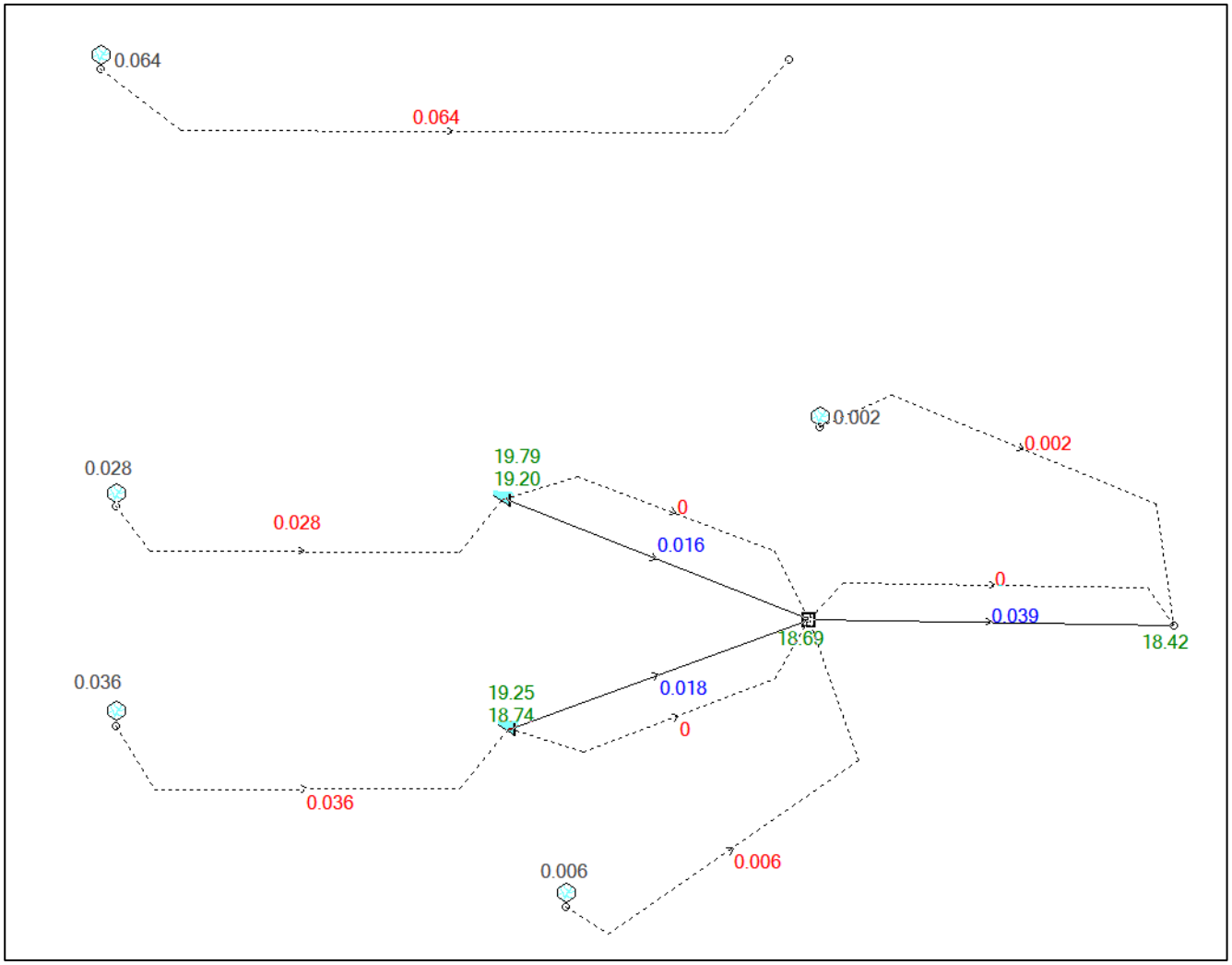
9. DRAINS Model Summary



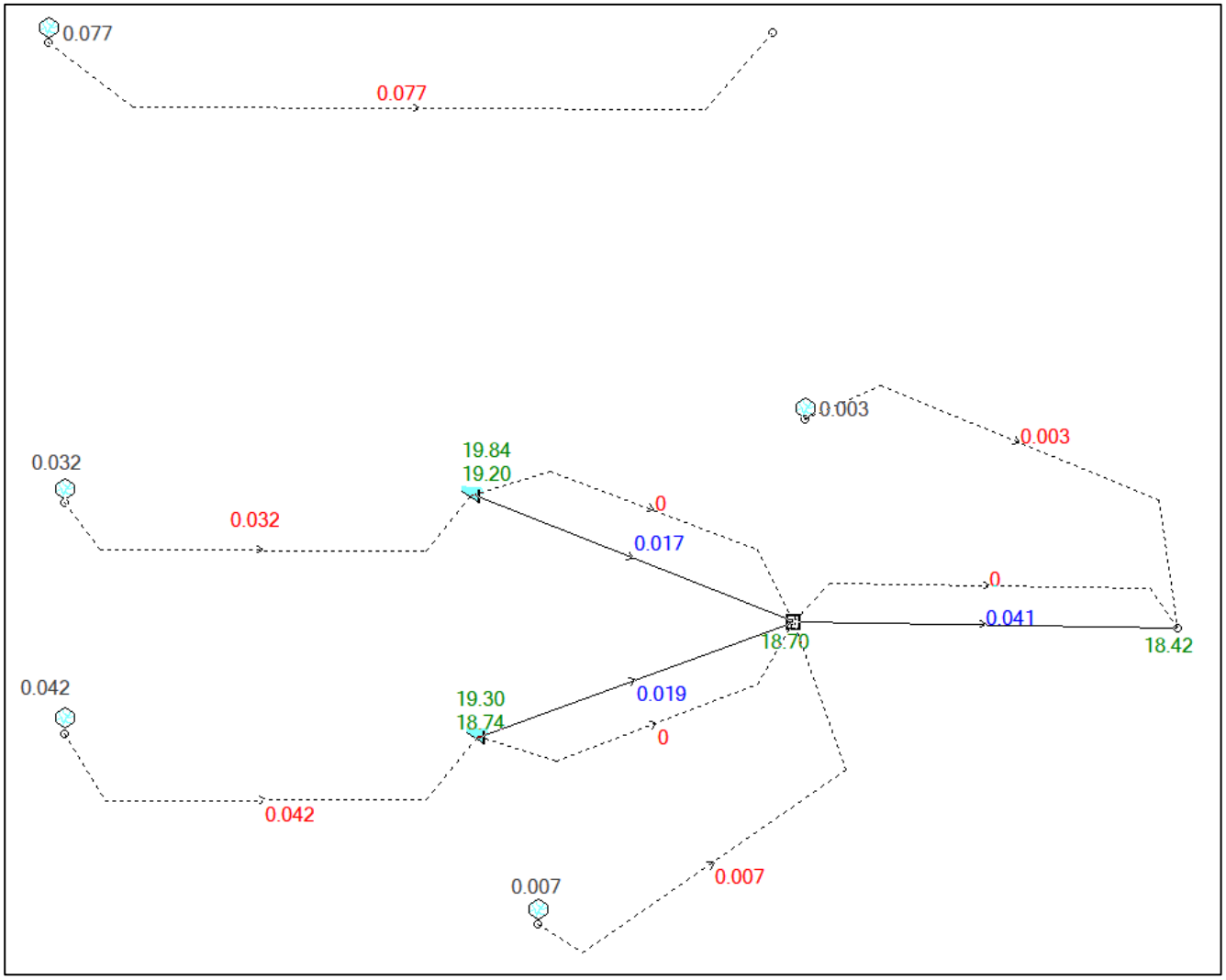
Overall set up of DRAINS Model



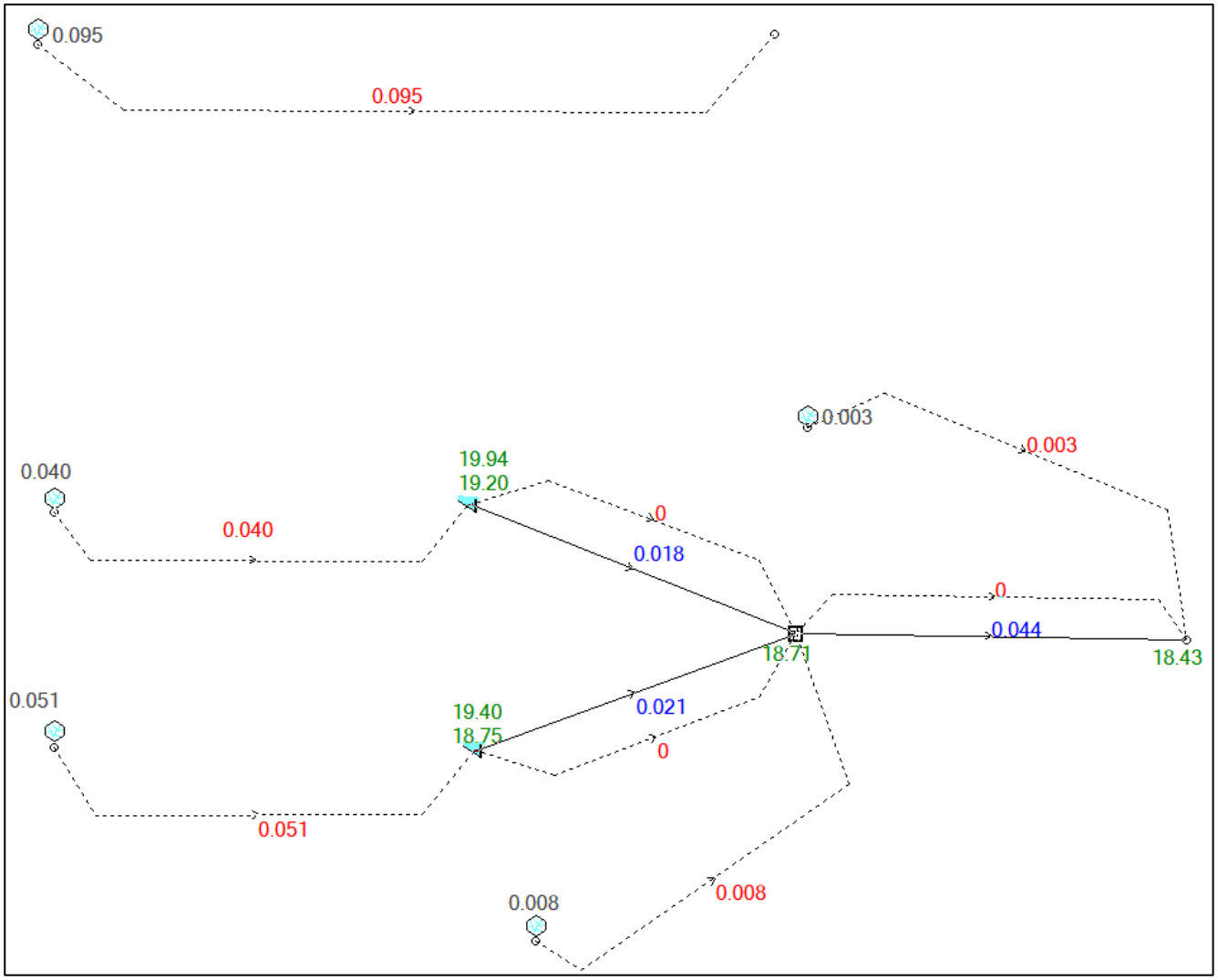
5Year Flow Summary – Minor Storm



10 Year Flow Summary – Minor Storm



20 Year ARI Flow Summary – Minor Storm



100 Year Flow Summary – Major Storm