

PROPOSED DEVELOPMENT OF LOT 5

OPERATIONAL WORKS FOR EARTHWORKS

LOT 5 BUSH CRESCENT, PARKHURST

BTRE 1 PTY LTD

D22.320

CIVIL DESIGN

ROCKHAMPTON REGIONAL COUNCIL

AMENDED PLANS APPROVED

27 October 2023

DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/139-2022

Dated: 7 March 2023



LOCALITY PLAN

(Not To Scale)



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DESIGN DRAWING LIST INDEX

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OPERATIONAL WORKS ISSUE

FOR CONSTRUCTION ONLY WITH COUNCIL APPROVAL

LEGEND

- EO EXISTING OVERHEAD ELECTRICITY
- T TELSTRA (CABLE & PIT)
- W EXISTING WATER MAIN
- S EXISTING SEWER MAIN & ACCESS CHAMBER
- D EXISTING STORMWATER MAIN
- K EXISTING KERB INLET

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HORIZONTAL
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REV	REVISION DESCRIPTION	DATE
A	FOR DISCUSSION	06/07/2022
B	OPERATIONAL WORKS	08/08/2022
C	RESPONSE TO RFI	19/12/2022
D	FURTHER ADVICE RESPONSE	09/02/2023
E	AMENDED EW SURFACE	01/06/2023
F	AMENDED FOR COUNCIL ADVICE	04/08/2023

DILEIGH
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01.09.2023	

BTRE 1 PTY LTD
PROPOSED DEVELOPMENT OF LOT 5
LOT 5 BUSH CRESCENT, PARKHURST
OPERATIONAL WORKS
EXISTING FEATURES AND SERVICES

Dwg No.	D22.320-01
CIVIL	
Revision	F

LEGEND

- EXISTING OVERHEAD ELECTRICITY
- TELSTRA (CABLE & PIT)
- EXISTING WATER MAIN
- EXISTING SEWER MAIN & ACCESS CHAMBER
- EXISTING STORMWATER MAIN
- EXISTING KERB INLET
- PROPOSED SEWER MAIN & ACCESS CHAMBER (DESIGN AND WORKS BY RRC)
- FUTURE SEWER CONNECTION (INDICATIVE ONLY)
- FUTURE SEWER STRUCTURE LABEL
- EARTH PLATFORM / FUTURE HARDSTAND PAD

EXISTING LEVELS AND SERVICES

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS AND LEVELS OF ALL EXISTING SERVICES WITH THE RELEVANT AUTHORITIES INCLUDING "DIAL BEFORE YOU DIG" PRIOR TO COMMENCING CONSTRUCTION.
2. ANY COSTS ASSOCIATED WITH REPAIRING DAMAGE TO EXISTING SERVICES SHALL BE PAID FOR BY THE CONTRACTOR.
3. THE CONTRACTOR SHALL VERIFY THAT THE EXISTING LEVELS ARE AS PER THIS DESIGN WHERE CONNECTIONS TO EXISTING INFRASTRUCTURE ARE REQUIRED. ANY DIFFERENCES TO BE NOTIFIED TO THE ENGINEER PRIOR TO ORDERING MATERIALS OR COMMENCING ANY WORKS.
4. PRIOR TO COMMENCING WORKS THE CONTRACTOR SHALL VERIFY THAT THERE ARE NO CLASHES BETWEEN ANY CROSSING SERVICE OR PIPELINE. ANY CLASHES TO BE NOTIFIED TO THE ENGINEER PRIOR TO WORKS COMMENCING.
5. PRIOR TO COMMENCING WORKS THE CONTRACTOR SHALL VERIFY LOCATION AND DETAILS OF ALL EXISTING SERVICE CONNECTIONS TO NEW ALLOTMENTS PREVIOUSLY INSTALLED

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AMENDED PLANS APPROVED

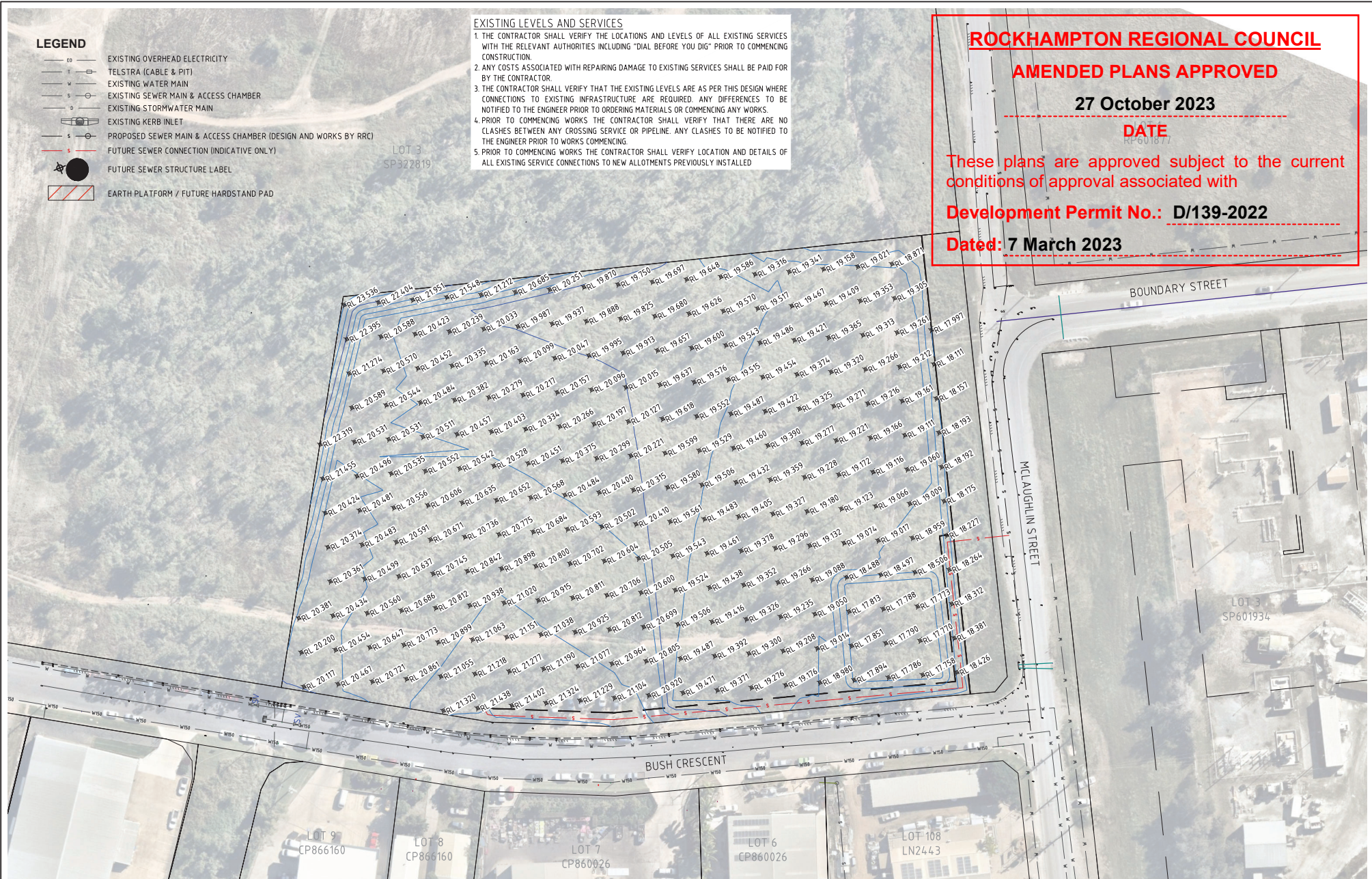
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PROPOSED DEVELOPMENT OF LOT 5
LOT 5 BUSH CRESCENT, PARKHURST
OPERATIONAL WORKS
EARTHWORKS FINISHED LEVELS

Dwg No.	D22.320-03
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Revision	F

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BULK EARTHWORKS

- ALL LAYERS SHALL BE UNIFORMLY COMPACTED TO NOT LESS THAN RELATIVE COMPACTION SPECIFIED BEFORE THE NEXT LAYER IS COMMENCED. EACH LAYOUT OF MATERIAL SHALL BE TRIMMED PRIOR TO AND DURING COMPACTION TO AVOID BRIDGING OVER LOW AREAS. A SMOOTH SURFACE SHALL BE PRESENTED AT THE TOP OF EACH LAYER.
- THE FOLLOWING AREAS SHALL BE COMPACTED TO PROVIDE A RELATIVE COMPACTION, DETERMINED BY AS 1289.5.7.1 FOR STANDARD COMPACTION EFFORT, OF NOT LESS THAN 95%:
 - EACH LAYER OF MATERIAL REPLACING UNSUITABLE MATERIAL.
 - EACH LAYER OF MATERIAL PLACED IN EMBANKMENTS, UP TO 0.3 METRES FROM THE TOP OF THE SUBGRADE.
 - THE WHOLE AREA ON THE FLOOR OF CUTTINGS.
 - FILL PLACED ADJACENT TO STRUCTURES UP TO 1.0 METRES FROM THE TOP OF PAVEMENT.
 - MATERIAL IN UNSEALED VERGES AND WITHIN MEDIANS UP TO THE LEVEL AT WHICH TOPSOIL IS PLACED.
 - SPOIL (EXCLUDING UNSUITABLE MATERIAL)
 - ALL OTHER AREAS EXCEPT THOSE WHERE 97% RELATIVE COMPACTION IS SPECIFIED.
- UNSUITABLE MATERIAL SHALL BE STOCKPILED AS DIRECTED BY THE SUPERINTENDENT AND UNSUITABLE EARTHWORKS COMPACTED BY TRACK ROLLING.
- THE FOLLOWING AREAS SHALL BE COMPACTED TO PROVIDE A RELATIVE COMPACTION OF NOT LESS THAN 98% AS DETERMINED BY AS 1289.5.7.1 FOR STANDARD COMPACTION EFFORT:
 - FOUNDATIONS FOR SHALLOW EMBANKMENTS.
 - EACH LAYOUT OF THE EMBANKMENT WITHIN 0.3 METRES FROM THE TOP OF THE SUBGRADE.
 - EACH LAYER OF THE SELECTED MATERIAL ZONE.
 - ANY AREAS OF MATERIAL OF SPECIFIED QUALITY WHICH MAY BE SHOWN IN THE DRAWINGS OR SPECIFIED ELSEWHERE BEHIND CURBS AND ALL GUTTERS OR ADJACENT TO RIGID PAVEMENTS.
 - THE FILL MATERIAL PLACED ADJACENT TO STRUCTURES WITHIN 1.0 METRES FROM THE TOP OF THE PAVEMENT, UNLESS OTHERWISE STATED.
- AT THE TIME OF COMPACTION, THE MOISTURE CONTENT OF THE MATERIAL SHALL BE ADJUSTED TO PERMIT THE SPECIFIED COMPACTION TO BE ATTAINED AT A MOISTURE CONTENT OF NOT LESS THAN 80% OR MORE THAN 100% OF THE OPTIMUM MOISTURE CONTENT AS DETERMINED BY AS1289.5.1.1 OR AS 1289.5.7.1. MATERIAL WHICH BECOMES WETTED UP AFTER PLACEMENT SHALL NOT BE COMPACTED UNTIL IT HAS DRIED OUT SO THAT THE MOISTURE CONTENT IS WITHIN THIS RANGE. THE DRYING PROCESS MAY BE ASSISTED BY AERATION. IF THERE IS INSUFFICIENT MOISTURE IN THE MATERIAL FOR IT TO BE COMPACTED AS SPECIFIED, WATER SHALL BE ADDED. THE ADDED WATER SHALL BE APPLIED UNIFORMLY AND THOROUGHLY MIXED WITH THE MATERIAL UNTIL A HOMOGENEOUS MIXTURE IS OBTAINED.
- COMPACTION SHALL BE UNDERTAKEN TO OBTAIN THE SPECIFIED RELATIVE COMPACTION FOR THE FULL DEPTH OF EACH LAYER IN EMBANKMENTS AND FOR THE FULL WIDTH OF THE FORMATION OVER THE ENTIRE LENGTH OF THE WORK. COMPACTION SHALL BE COMPLETED PROMPTLY TO MINIMISE THE POSSIBILITY OF RAIN DAMAGE.
- ANY MATERIAL PLACED BY THE CONTRACTOR THAT HAS ATTAINED THE SPECIFIED RELATIVE COMPACTION BUT SUBSEQUENTLY BECOMES WETTED UP SO THAT THE MOISTURE CONTENT IS GREATER THAN THE APPARENT OPTIMUM, DETERMINED BY AS1289.5.7.1 SHUT SHALL BE DRIED OUT AND UNIFORMLY RE-COMPACTED TO THE REQUIRED RELATIVE COMPACTION IN ACCORDANCE WITH THIS CLAUSE BEFORE THE NEXT LAYER OF MATERIAL IS PLACED. ALTERNATIVELY, THE CONTRACTOR MAY REMOVE THE LAYER OF WETTED MATERIAL TO A STOCKPILE SITE FOR DRYING AND LATER REUSE.
- FOLLOWING COMPLETION OF COMPACTION AND TRIMMING, THE ENTIRE SUBGRADE AREA SHALL BE INSPECTED BY PROOF ROLLING WITH A FULLY LOADED SINGLE REAR AXLE TRUCK (OR ACCEPTABLE EQUIVALENT). ACCEPTABLE PROOF ROLLING SHALL BE TAKEN TO BE NO VISIBLE SIGNS OF DEFORMATION OR INSTABILITY IN THE SUBGRADE.
- THE SPECIFIED COMPACTION AND MOISTURE TESTS SHALL BE TAKEN AT THE RANDOM TEST FREQUENCY, PRIOR TO TESTING THE CONTRACTOR SHALL WORK THE LOT TO ENSURE UNIFORM MOISTURE CONTENT AND COMPACTION OF ALL MATERIAL WITHIN THE LOT. THE TESTS THEN TAKEN SHALL BE CONSIDERED TO REPRESENT THE TOTAL VOLUME OF MATERIAL PLACED WITHIN THE LOT.
- LIMITS AND TOLERANCES:
 - BATTER SLOPES: EXCAVATION $\pm 300\text{MM}$, FILL $\pm 300\text{MM}$
 - FLOOR OF CUTTING: $\pm 50\text{MM}$ PARALLEL TO THE DESIGNED GRADE LINE
 - TOP OF EMBANKMENT: $\pm 10\text{MM}$ FROM THE GRADE LINE.

LEGEND

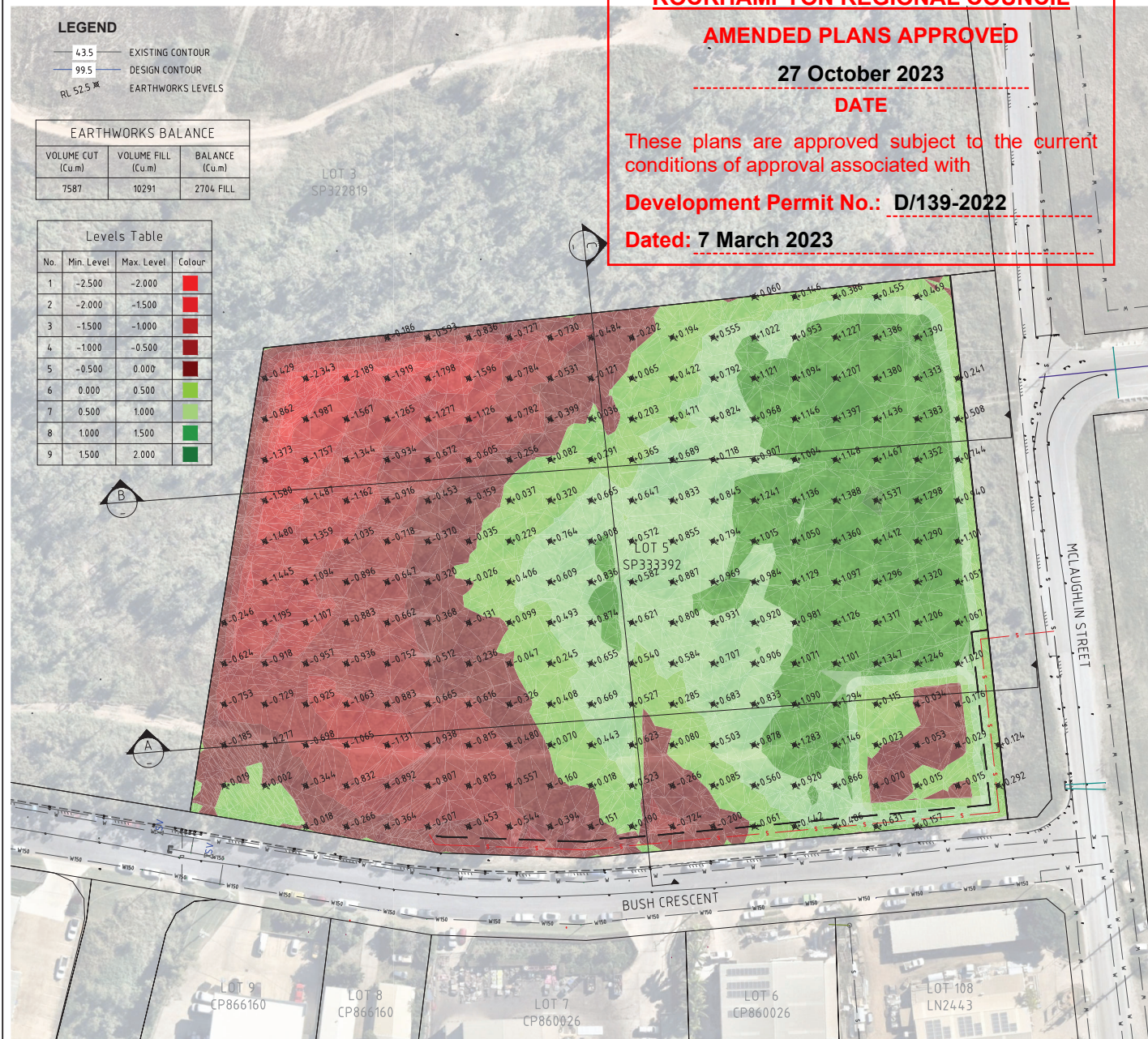
- 43.5 EXISTING CONTOUR
- 99.5 DESIGN CONTOUR
- RL 52.5 EARTHWORKS LEVELS

EARTHWORKS BALANCE

VOLUME CUT (Cu.m)	VOLUME FILL (Cu.m)	BALANCE (Cu.m)
7587	10291	2704 FILL

Levels Table

No.	Min. Level	Max. Level	Colour
1	-2.500	-2.000	Red
2	-2.000	-1.500	Red
3	-1.500	-1.000	Red
4	-1.000	-0.500	Red
5	-0.500	0.000	Red
6	0.000	0.500	Green
7	0.500	1.000	Green
8	1.000	1.500	Green
9	1.500	2.000	Green



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DILEIGH
CIVIL/STRUCTURAL DESIGN & PROJECT MANAGEMENT

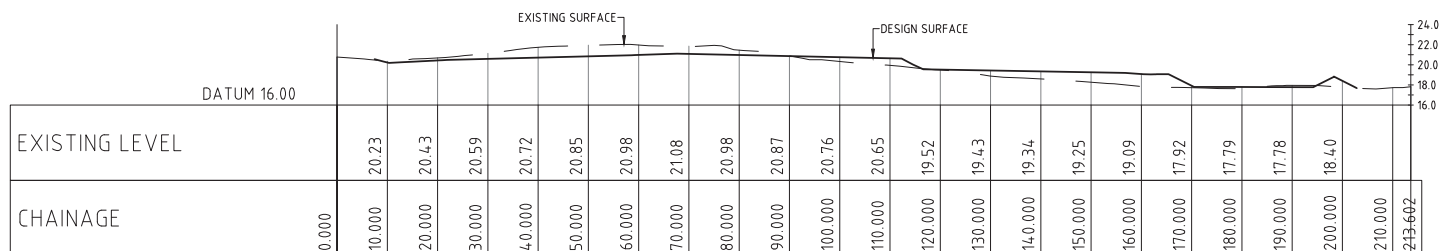
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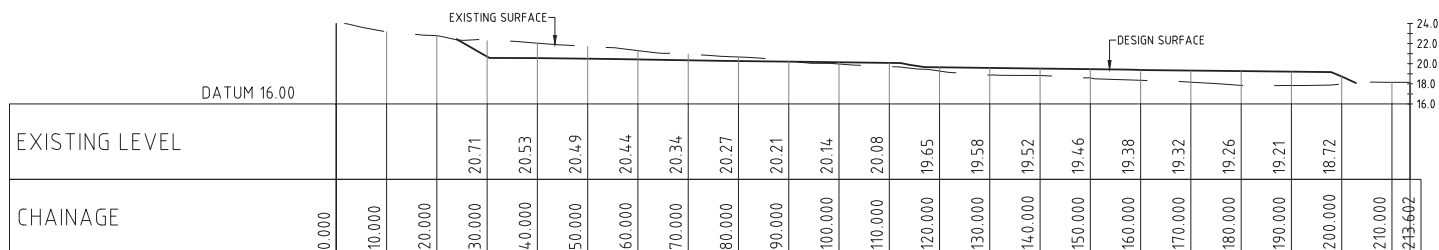
BTRE 1 PTY LTD
PROPOSED DEVELOPMENT OF LOT 5
LOT 5 BUSH CRESCENT, PARKHURST
OPERATIONAL WORKS
EARTHWORKS PLAN

Dwg No.	D22.320-04
Revision	F

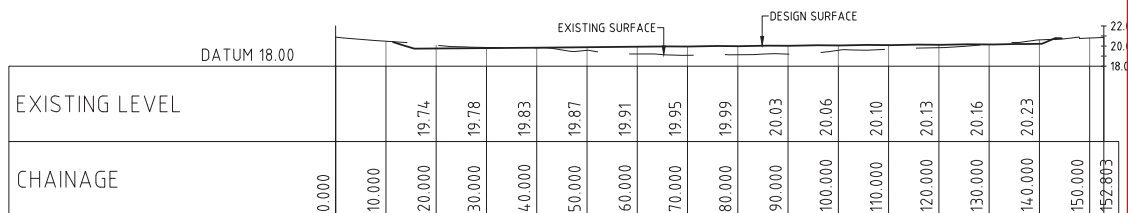
(SECTION A)



(SECTION B)



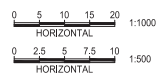
(SECTION C)

**ROCKHAMPTON REGIONAL COUNCIL****AMENDED PLANS APPROVED****27 October 2023****DATE**

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LOT 5 BUSH CRESCENT, PARKHURST
OPERATIONAL WORKS
EARTHWORKS PROFILE SECTIONS

Dwg No.	D22.320-05
CIVIL	
Revision	F

LEGEND

- EO EXISTING OVERHEAD ELECTRICITY
- T TELSTRA (CABLE & PIT)
- W EXISTING WATER MAIN
- S EXISTING SEWER MAIN & ACCESS CHAMBER
- D EXISTING STORMWATER MAIN
- EXISTING KERB INLET
- S PROPOSED SEWER MAIN & ACCESS CHAMBER
- PROPOSED SEDIMENT FENCE
- PROPOSED HAY BALES

ROCKHAMPTON REGIONAL COUNCIL

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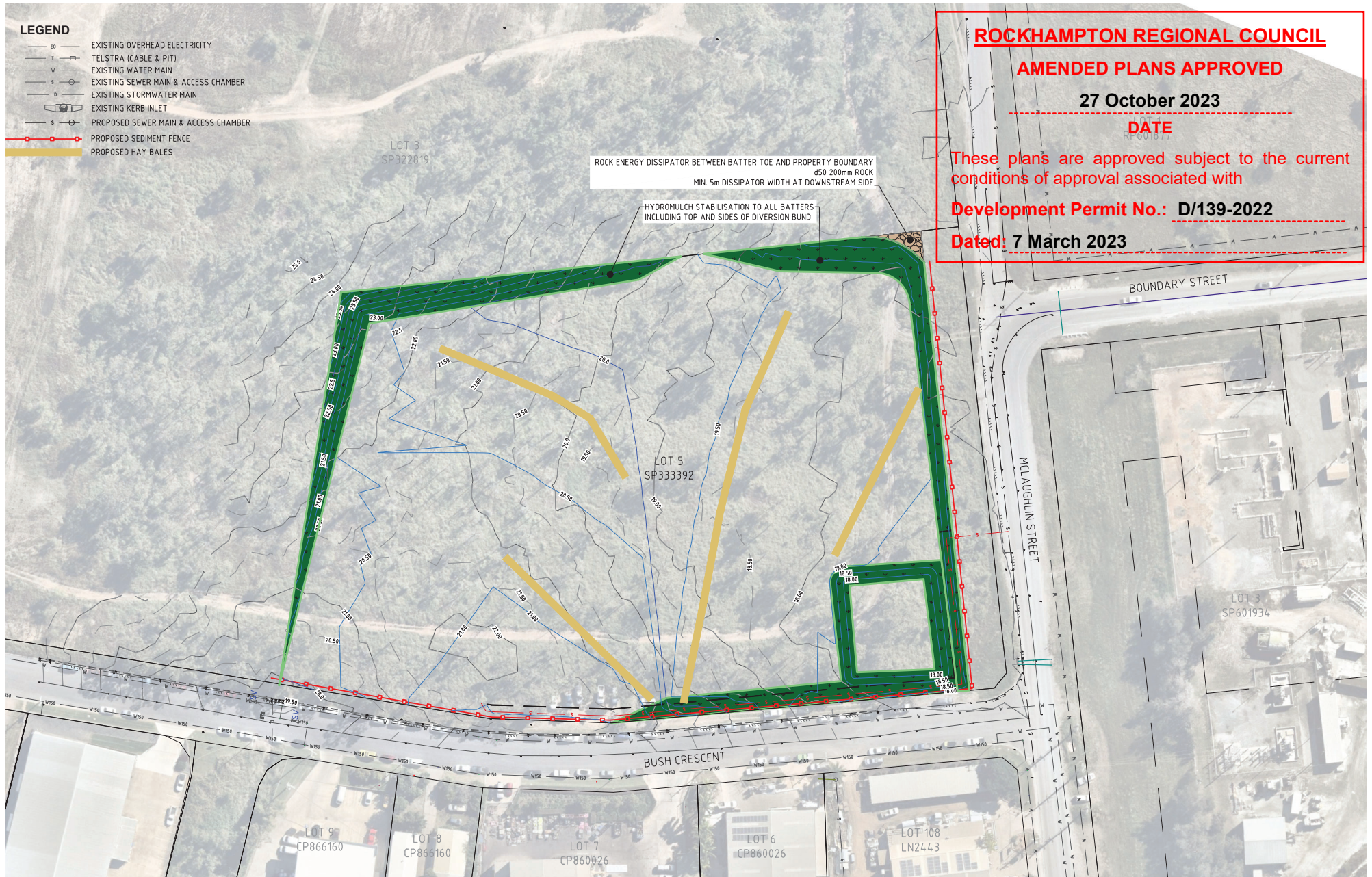
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ROCK ENERGY DISSIPATOR BETWEEN BATTER TOE AND PROPERTY BOUNDARY
d50 200mm ROCK
MIN. 5m DISSIPATOR WIDTH AT DOWNSTREAM SIDE

HYDROMULCH STABILISATION TO ALL BATTERS
INCLUDING TOP AND SIDES OF DIVERSION BUND



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LOT 5 BUSH CRESCENT, PARKHURST
OPERATIONAL WORKS
SEDIMENT AND EROSION CONTROL PLAN

Dwg No.	D22.320-07
CIVIL	
Revision	F

ENVIRONMENTAL MANAGEMENT NOTES:

1. PRIOR TO THE COMMENCEMENT OF EARTHWORKS, TOPSOIL SHALL BE STRIPPED AND STOCKPILED FROM SELECT AREAS ONLY FOR RE-SPREADING OVER DISTURBED AREAS PRIOR TO REVEGETATION AND LANDSCAPING.
2. PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS ALL SEDIMENT CONTROL DEVICES WILL BE ERECTED WHERE SHOWN ON THE DRAWINGS OR OTHERWISE DIRECTED BY THE ENGINEER.
3. ALL DISTURBED AREAS ON-SITE AND IN ROAD RESERVE WILL BE RE-TOPSOILED, TURFED OR LANDSCAPED.
4. ALL SOIL CONSERVATION AND ENVIRONMENTAL PROTECTION MEASURES SHALL BE MONITORED BY THE CONTRACTOR AT REGULAR INTERVALS DURING CONSTRUCTION. SEDIMENT CONTROL DEVICES WILL BE MONITORED AFTER RAIN EVENTS AND MADE GOOD WHERE NECESSARY. THIS WILL ALSO BE CARRIED OUT DURING THE DEFECTS LIABILITY PERIOD.
5. SILT FENCES SHALL BE INSTALLED ON THE LOW SIDE OF ALL STOCKPILES WHERE REQUIRED.
6. SILT FENCES SHALL REMAIN ON SITE UNTIL ALL CONSTRUCTION ACTIVITIES ARE COMPLETE AND THERE IS 90% VEGETATION COVERAGE OF PROPOSED LANDSCAPED AREAS.

NOISE MANAGEMENT:

1. **WORKING HOURS** - WORKING HOURS FOR THE SITE ARE TO BE 6.30am TO 6.30pm MONDAY TO SATURDAY. NO WORK TO BE UNDERTAKEN OUTSIDE OF TIMES SPECIFIED UNDER ANY CIRCUMSTANCES.
2. **NOISE MINIMISATION METHODS** - NOISE WILL BE MINIMISED USING THE FOLLOWING METHODS:-
 - 2.1. RESTRICTED WORKING HOURS AS DETAILED ABOVE
 - 2.2. NOISE GENERATING MACHINERY TO OPERATED ONLY WHEN NECESSARY TO UNDERTAKE WORKS - VEHICLES AND MACHINERY ARE NOT TO BE LEFT 'IDLING' WHEN NOT IN USE.
 - 2.3. NOISE SHIELDING ON PLANT TO BE INSPECTED PRIOR TO COMMENCEMENT OF WORKS AND MADE GOOD WHERE FOUND TO BE FAULTY.
 - 2.4. VEHICLES AND MACHINERY TO BE REGULARLY MAINTAINED TO REDUCE ENGINE NOISE THROUGH INFREQUENT MAINTENANCE.

DUST MANAGEMENT:

1. **MINIMISING DUST GENERATION** - THE FOLLOWING WORK PRACTICES WILL BE USED TO MINIMISE DUST GENERATION:-
 - 1.1. WIND CONDITIONS ON SITE ARE TO BE MONITORED AND SITE WORKS STOPPED IF WIND STRENGTH IS SUCH THAT EFFORTS TO MINIMISE AND/OR SUPPRESS DUST ARE INEFFECTIVE.
 - 1.2. SOIL STABILISATION OF BATTERS (THROUGH TOPSOILING AND REVEGETATION) TO BE UNDERTAKEN IMMEDIATELY AFTER FINAL TRIM TO MINIMISE EXPOSURE OF BARE EARTH.
 - 1.3. STOCKPILES INTENDING TO BE LEFT IN PLACE FOR 28 DAYS OR GREATER SHALL BE GRASS SEEDDED.
2. **DUST SUPPRESSION** -
 - 2.1. WET DOWN DUST GENERATING SURFACES DAILY PRIOR TO COMMENCEMENT OF WORK USING WATER TRUCKS, SPRINKLERS AND HOSE WATERING BY HAND.
 - 2.2. ADDITIONAL WETTING DOWN OF SITE AREAS IS TO BE UNDERTAKEN AS NEEDED DURING THE COURSE OF THE DAY WHERE WORK AREAS HAVE DRIED AND ARE GENERATING DUST.

WEED MANAGEMENT:

1. **MOVEMENT OF SOIL** - EXISTING TOP SOIL IS TO BE STOCKPILED AND RE-USED ON SITE AFTER SITE WORKS ARE COMPLETE, ANY ADDITIONAL TOP SOIL REQUIRED IS TO BE FREE OF PLANT SEEDS PRIOR TO SPREADING ON SITE.
2. **FILL MATERIAL** - FILL MATERIAL TO BE IMPORTED ON SITE IS TO BE 'CLEAN FILL' AND FREE FROM ANY ORGANIC MATTER OR MATERIALS.

EMERGENCY VEHICLE ACCESS:

1. MAINTAIN CLEAR ACCESS TO SITE FOR EMERGENCY VEHICLES AT ALL TIMES

WASTE MANAGEMENT:

1. ALL LITTER AND WASTE TO BE CONTAINED ON SITE IN CONTAINERS PROVIDED FOR THAT PURPOSE.
2. ALL WASTE TO BE FURTHER DISPOSED OFF SITE IN A RESPONSIBLE MANNER.
3. WHERE POSSIBLE MINIMISE WASTE THROUGH WASTE MINIMIZATION AND RE-USE.

EROSION AND SEDIMENT MANAGEMENT:

DRAINAGE MANAGEMENT - WHERE POSSIBLE, RAINWATER DISCHARGE FROM UPSTREAM PROPERTIES IS TO BE DIRECTED AWAY FROM WORKS THROUGH TEMPORARY BUNDING.

1. **SOIL STABILISATION** -
 - 1.1. EXPOSED EARTH SHALL BE TOPSOILED, VEGETATED, AND LANDSCAPED AS SOON AS POSSIBLE AFTER TRIMMING.
 - 1.2. RE-VEGETATED AND LANDSCAPED AREAS SHALL BE REGULARLY WATERED TO ASSIST ESTABLISHMENT OF COVER.
 - 1.3. ALL BANKS AND BATTERS ARE TO BE REGULARLY INSPECTED TO IDENTIFY AREAS OF EROSION AND RESHAPED TO PREVENT FURTHER EROSION IF NECESSARY - RECTIFICATION WORKS ARE TO BE RE-VEGETATED IMMEDIATELY.
2. **STOCKPILE PROTECTION** -
 - 2.1. STOCKPILES ARE TO BE SITUATED SUCH THAT THEY ARE NOT IN ANY STORMWATER FLOW PATHS.
 - 2.2. SILT FENCING IS TO BE INSTALLED TO DOWNSTREAM SIDE OF STOCKPILE AREAS PRIOR TO THEIR USE.
 - 2.3. STOCKPILES INTENDING TO BE LEFT IN PLACE FOR 28 DAYS OR GREATER SHALL BE GRASS SEEDDED.
 - 2.4. STOCKPILES TO HAVE A MAXIMUM SLOPE OF 2H:1V.
3. **SEDIMENT TRAPS** -
 - 3.1. SILT FENCING & SEDIMENT TRAPS TO BE INSTALLED AT AREAS OF SITE DISCHARGE AS SHOWN ON PLAN.
 - 3.2. SILT FENCING TO BE INSTALLED TO DOWNSTREAM SIDE OF STOCKPILE AREAS, STRIPPED AREAS, AND ANY OTHER AREAS OF BARE EARTH WHERE SILT LADEN RUNOFF CAN BE GENERATED.
 - 3.3. SEDIMENT FENCING TO BE INSTALLED IN ACCORDANCE WITH SEDIMENT FENCE DETAILS ON THIS SHEET.
 - 3.4. SEDIMENT FENCE LAYOUT SHALL CONFORM TO "TYPICAL LAYOUT ACROSS GRADE" AS DETAILED ON STANDARD DRAWING CMDG-D-050.
 - 3.5. SILT FENCES AND SEDIMENT TRAPS SHALL REMAIN ON SITE UNTIL ALL CONSTRUCTION ACTIVITIES ARE COMPLETE AND THERE IS 90% VEGETATION COVERAGE OF PROPOSED LANDSCAPED AREAS.
4. **VEHICLE AND ROAD MANAGEMENT**:-
 - 4.1. VEHICLES AND PLANT ARE TO ONLY ACCESS THE SITE FROM BUSH CRESCENT SITE ACCESS TO BE OVER A SHAKER ACCESS PAD OR RUMBLE GRID IN ACCORDANCE WITH STANDARD DWG CMDG-D-050.
 - 4.2. VEHICLE OPERATOR TO ASSESS MATERIAL ON VEHICLE PRIOR TO EXITING SITE AND REMOVE EXCESS WITH SHOVEL OR BRUSH.
 - 4.3. BUSH CRESCENT TO BE INSPECTED AT END OF EACH DAY AND ANY DEPOSITED MATERIAL IS TO BE REMOVED.

ACID SULFATE SOILS:

1. DUE TO THE ELEVATION AND SITE GEOLOGY IT IS UNLIKELY THAT A.S.S. WILL BE ENCOUNTERED ON THIS SITE.
2. IF A.S.S. ARE ENCOUNTERED ON THE SITE DURING CONSTRUCTION ENGAGE A SUITABLY QUALIFIED ENVIRONMENTAL CONSULTANT TO PRODUCE AN A.S.S. MANAGEMENT PLAN FOR IT.

FAUNA MANAGEMENT:

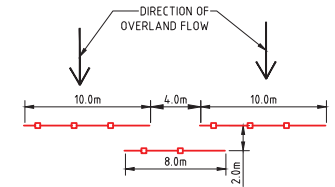
1. ANY CLEARING OF REMNANT VEGETATION WILL REQUIRE A FAUNA SPOTTER / CATCHER TO BE IN ATTENDANCE.

VEGETATION MANAGEMENT:

1. WHERE VEGETATION COVENANT EXISTS ON SITE. THIS AREA TO BE CLEARLY PEGGED AND FLAGGED OR FENCED PRIOR TO WORK COMMENCING ON SITE TO PREVENT ANY CLEARING IN THIS AREA.

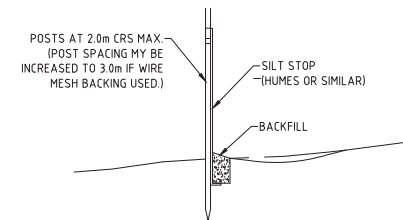
BUSH FIRE MANAGEMENT:

1. THE SITE IS PREDOMINANTLY CLEARED AND NOT IN A BUSH FIRE HAZARD ZONE (BUT STILL MAY BE SUBJECT TO BUSH FIRES).
2. ANY CLEARED VEGETATION TO BE MULCHED AND USED ON SITE.
3. MULCHED STOCK PILES TO BE NO MORE THAN 2.0m HIGH AND WET DOWN DAILY.
4. REMOVE MULCH FROM SITE IF SAFE TO DO SO SHOULD BUSHFIRES THREATEN THE AREA.



SEDIMENT FENCE DETAIL

N.T.S.



SEDIMENT FENCE DETAIL

N.T.S.

ROCKHAMPTON REGIONAL COUNCIL

AMENDED PLANS APPROVED

27 October 2023

DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/139-2022

Dated: 7 March 2023

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HORIZONTAL
1:1000

OPERATIONAL WORKS ISSUE

FOR CONSTRUCTION ONLY WITH COUNCIL APPROVAL

REV	REVISION DESCRIPTION	DATE
A	FOR DISCUSSION	06/07/2022
B	OPERATIONAL WORKS	08/08/2022
C	RESPONSE TO RFI	19/12/2022
D	FURTHER ADVICE RESPONSE	09/02/2023
E	AMENDED EW SURFACE	01/08/2023
F	AMENDED FOR COUNCIL ADVICE	04/08/2023

DILEIGH
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Designed	TAH/AML
Checked	GJB
Approved	GLENN J BROWN
RPEQ 7682	Sign
01.09.2023	

BTRE 1 PTY LTD
PROPOSED DEVELOPMENT OF LOT 5
LOT 5 BUSH CRESCENT, PARKHURST
OPERATIONAL WORKS
ENVIRONMENTAL MANAGEMENT NOTES

Dwg No.	D22.320-08
	CIVIL
Revision	F

2022



CIVIL / STRUCTURAL DESIGN & PROJECT MANAGEMENT

Ashleigh Lucas

ROCKHAMPTON REGIONAL COUNCIL

AMENDED PLANS APPROVED

27 October 2023

DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/139-2022

Dated: 7 March 2023

**MATERIAL CHANGE OF USE FOR A WAREHOUSE
LOT 5 ON SP333392**

STORMWATER MANAGEMENT PLAN

FOR JRT CIVIL PTY LTD

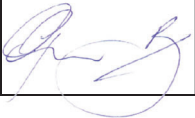
D22.320

JRT CIVIL PTY LTD

STORMWATER MANAGEMENT PLAN

MATERIAL CHANGE OF USE FOR A WAREHOUSE LOT 5 ON SP333392

Document History & Status

REVISION	DATE	ISSUED TO	APPROVED FOR ISSUE BY	SIGNATURE	DATE
A	25/01/2023	Rockhampton Council Regional	Glenn Brown RPEQ 7682		
B	01/06/2023	Rockhampton Council Regional	Glenn Brown RPEQ 7682		
C	04/08/2023	Rockhampton Council Regional	Glenn Brown RPEQ 7682		07.08.2023

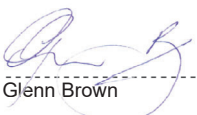
Prepared By



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Reference: D22.320-RP01

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1. Introduction

This report was prepared for JRT Civil Pty Ltd in support of a proposed development to the subject site at 5 Bush Crescent, Parkhurst. The proponent is seeking approval to undertake bulk earthworks (Operational Works) and develop the site with a donga site office and industrial storage area (Material Change of Use).

The land subject to this application is described as Lot 5 on SP333392 which has a developable area of 2.401ha.

2. Stormwater Quantity Management

2.1 Analysis Methodology

As described in the Queensland Urban Drainage Manual (QUDM), the Rational Method is a “simplistic hydrologic method with a modest degree of accuracy compared to numerical runoff-routing models” and is not recommended for “the analysis or design of drainage systems that are volume-dependent, such as detention and retention systems”. Therefore, it is best practice to utilise runoff routing models such as RORB for the design of a detention system.

A Monte Carlo analysis was performed in RORB for both pre-development and post-development catchments to size the detention basin required to ensure post-development peak discharges for all Annual Exceedance Probabilities (AEPs) did not exceed pre-development peak discharges up to and including a 1% AEP flood event.

Rainfall data and catchment files used for modelling are included in Appendix A for information.

In the absence of catchment specific calibration data, the following coefficients for both pre-development and post-development catchments were adopted:

- $m = 0.8$ (recommended by RORB developers)
- $Kc = 0.88 \times A^{0.53}$ (Catchment specific regional calculation for Queensland catchments)

2.2 Pre Development Stormwater Conditions

The pre-developed site consists of dense vegetation with an access track. Runoff from the site generally flows overland across the east boundary as sheet flow to McLaughlin Street. The sheet flow is captured by a table drain in the verge between the road and property boundary and directed to a culvert running under McLaughlin Street in close proximity to the Bush Crescent intersection. Refer Existing Site Layout Plan D22.320-SW01. The south west corner of the site falls towards Bush Crescent with runoff discharging as sheet flow.

A Monte Carlo analysis was modelled in RORB for the pre-development site conditions.

Pre-development catchment are documented in drawings D22.320-SW01 (refer Appendix B).

Pre-development peak flows for both sets of catchments are tabulated below.

Event AEP (%)	Peak Discharge (m ³ /s)	Critical Duration
63.2	0.086	6 hours
50	0.138	2 hours
20	0.345	1 hour
10	0.448	1 hour
5	0.581	30 minutes
2	0.751	30 minutes
1	0.869	30 minutes

A copy of RORB input and output files for the pre-development catchment are included in Appendix C.

2.3 Untreated Post Development Flows

A post-development overall site fraction impervious of 0.75 for a compacted brownfield site was adopted in line with council advice.

The intended eventual layout of the post developed site has not been finalised. The gravel access / carpark and temporary structures shown on the MCU plans are indicative only and are likely to differ at future stages of the development.

Post development site levels fall entirely to the east including the south west corner, which has been filled to prevent overland flow from discharging to Bush Crescent.

All external catchments will continue to flow to the downstream point of discharge unchanged from pre-development conditions.

A Monte Carlo analysis was modelled in RORB for the post-developed catchments.

Untreated post-development peak flows for the internal catchments only are tabulated below.

Event AEP (%)	Peak Discharge (m ³ /s)	Critical Duration
63.2	0.387	20 minutes
50	0.442	20 minutes
20	0.621	30 minutes
10	0.753	20 minutes
5	0.873	20 minutes
2	1.073	25 minutes
1	1.190	25 minutes

The following increase in internal site flows when compared to pre-development were noted.

Event AEP (%)	Pre-Development Peak Discharge (m ³ /s)	Untreated Post-Development Peak Discharge (m ³ /s)	Change (%)
63.2	0.086	0.387	350%
50	0.138	0.442	220%
20	0.345	0.621	80%
10	0.448	0.753	68%
5	0.581	0.873	50%
2	0.751	1.073	43%
1	0.869	1.190	37%

A copy of RORB input and output files for the untreated post-development catchment are included in Appendix D.

2.4 Treated Post Development Flows

Treatments outlined in this report are intended for the earthworks phase of the development only. Additional documentation, including a revised Stormwater Management Plan, is to be undertaken at future stages of the proposed development when the proposed layout has been finalised.

Quantity mitigation is not considered necessary at this stage. While it has been noted that there is an increase in site runoff due to the change in current surfacing finish and imperviousness. We expect this increase in runoff will gradually reduce over short period of time as the site naturally becomes grassed and returns to a condition similar to the predeveloped state.

While in the current barren state immediately following the earthworks, additional measures will be taken to reduce the velocity of stormwater runoff from the site. Refer Erosion and Sediment Control Plan.

2.4.1 Sediment Control

It is proposed to control sediment runoff from the site with the provision of a Type D sediment basin. An approximately 700m³ basin was constructed at the downstream south-east corner of the post earthworks site. Sizing calculations were undertaken in line with IECA Australasia Appendix B June 2018, which indicates that the basin in its current formation will adequately service the subject site.

A portion of minor and major overland flows (Catchment A) will be captured via a bund wall along the eastern boundary directing flows to the sediment / detention basin prior to discharging to McLaughlin Street. The remainder of overland site flows (Catchment B) will flow directly into the basin.

A 200mm sediment storage zone is provided below the low-flow outlet, with a 650mm sediment settling zone above. The basin is 850mm in total depth with 1 in 4 batters to the design surface. The invert level of the basin will be at natural level, excluding some filling in an existing depression which is not free draining. Refer Flood Impact Advice Statement D22.320-RF12.

Inspection of the sediment basin is to be undertaken every 2 months until the site progresses to a future stage of development, during which the basin will be decommissioned in line with future stormwater management plans. Removal of deposited sediment is to be undertaken as required following this inspection as required or deemed necessary to maintain successful sediment removal.

The outlet of the sediment basin is sized to allow major flows to exit the site, and is to be constructed in the following shape:

- 1x 150mm uPVC low-flow outlet pipes at the invert level of the basin
- 7.0m wide broad crested weir at 0.6m above natural surface/bottom of basin level

Basin and weir construction details are included in the plans in Appendix B.

2.4.2 Erosion Control

Erosion control is to be undertaken via the following measures:

- Grass seeding to be provided to all disturbed batters.
- Haybales to be provided in sections following the fall of the post-earthworks site located along the major flow paths.
- A rock energy dissipator in the northeast corner at the toe of the batter where external catchments may become concentrated against the batter, with a minimum dissipator width of 5m at the downstream property boundary.

3. Stormwater Quality Management

Stormwater Quality Improvement Devices (SQIDs) are not proposed at this time., but maybe incorporated with further development of the site and will be documented accordingly at this stage of the development.

4. Conclusion

The stormwater management and sediment and erosion control plan for the subject site has been prepared for the earthworks phase only. It is proposed to implement sediment and erosion control with construction and ongoing maintenance of a sediment basin and placement of haybales, grass seeding and rock energy dissipators.

Any further development

Ashleigh Lucas
For and On Behalf of
Dileigh Consulting Engineers Pty Ltd

Appendix A – Australian Rainfall and Runoff Data Files

Results - ARR Data Hub
[STARTTXT]

Input Data Information
[INPUTDATA]
Latitude,-25.551400
Longitude,152.677100
[END_INPUTDATA]

River Region
[RIVREG]
Division,North East Coast
River Number,38
River Name,Mary River (Qld)
[RIVREG_META]
Time Accessed,04 April 2022 01:44PM
Version,2016_v1
[END_RIVREG]

ARF Parameters
[LONGARF]
Zone,East Coast North
a,0.327
b,0.241
c,0.448
d,0.36
e,0.00096
f,0.48
g,-0.21
h,0.012
i,-0.0013
[LONGARF_META]
Time Accessed,04 April 2022 01:44PM
Version,2016_v1
[END_LONGARF]

Storm Losses
[LOSSES]
Storm Initial Losses (mm),35.0
Storm Continuing Losses (mm/h),2.0
[LOSSES_META]
Time Accessed,04 April 2022 01:44PM
Version,2016_v1
[END_LOSSES]

Temporal Patterns
[TP]
code,ECnorth
Label,East Coast North
[TP_META]
Time Accessed,04 April 2022 01:44PM
Version,2016_v2
[END_TP]

Areal Temporal Patterns

[ATP]
code,ECnorth
arealabel,East Coast North
[ATP_META]
Time Accessed,04 April 2022 01:44PM
Version,2016_v2
[END_ATP]

Median Preburst Depths and Ratios

[PREBURST]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),2.0 (0.047),4.3 (0.074),5.9 (0.085),7.4 (0.092),9.2 (0.097),10.6 (0.100)
90 (1.5),1.7 (0.035),5.8 (0.087),8.5 (0.107),11.1 (0.121),10.8 (0.099),10.6 (0.086)
120 (2.0),2.3 (0.043),8.5 (0.116),12.6 (0.144),16.5 (0.163),16.6 (0.136),16.6 (0.121)
180 (3.0),3.2 (0.054),9.6 (0.116),13.9 (0.140),18.0 (0.154),26.2 (0.187),32.4 (0.204)
360 (6.0),3.3 (0.045),8.3 (0.081),11.7 (0.093),14.9 (0.101),31.5 (0.175),44.0 (0.214)
720 (12.0),5.2 (0.056),12.4 (0.093),17.1 (0.106),21.7 (0.113),44.2 (0.188),61.1 (0.226)
1080 (18.0),1.1 (0.010),9.5 (0.062),15.1 (0.080),20.5 (0.091),34.1 (0.123),44.3 (0.139)
1440 (24.0),3.3 (0.028),7.3 (0.043),10.0 (0.048),12.6 (0.050),33.1 (0.107),48.5 (0.136)
2160 (36.0),0.0 (0.000),3.0 (0.015),5.1 (0.021),7.0 (0.024),23.7 (0.065),36.2 (0.086)
2880 (48.0),0.0 (0.000),2.6 (0.012),4.3 (0.016),5.9 (0.018),18.0 (0.045),27.0 (0.058)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),9.0 (0.020),15.7 (0.030)

[PREBURST_META]

Time Accessed,04 April 2022 01:44PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST]From preburst class

10% Preburst Depths

[PREBURST10]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.3 (0.001),0.5 (0.002)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

[PREBURST10_META]

Time Accessed,04 April 2022 01:44PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST10]From preburst class

25% Preburst Depths

[PREBURST25]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),0.0 (0.000),0.3 (0.005),0.4 (0.006),0.6 (0.008),0.7 (0.008),0.8 (0.008)
90 (1.5),0.0 (0.000),0.3 (0.005),0.6 (0.007),0.8 (0.008),1.3 (0.012),1.7 (0.014)
120 (2.0),0.0 (0.000),0.8 (0.011),1.3 (0.015),1.8 (0.018),1.5 (0.013),1.3 (0.010)
180 (3.0),0.0 (0.000),0.6 (0.007),1.0 (0.010),1.4 (0.012),3.3 (0.023),4.7 (0.030)

360 (6.0),0.0 (0.000),0.5 (0.005),0.8 (0.006),1.1 (0.007),3.4 (0.019),5.1 (0.025)
 720 (12.0),0.0 (0.000),1.1 (0.009),1.9 (0.012),2.6 (0.014),8.1 (0.034),12.1 (0.045)
 1080 (18.0),0.0 (0.000),0.4 (0.002),0.6 (0.003),0.9 (0.004),5.6 (0.020),9.2 (0.029)
 1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),2.6 (0.008),4.5 (0.013)
 2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),1.6 (0.004),2.8 (0.007)
 2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
 4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)

[PREBURST25_META]

Time Accessed,04 April 2022 01:44PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST25]From preburst class

75% Preburst Depths

[PREBURST75]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),27.2 (0.638),29.7 (0.509),31.4 (0.453),33.0 (0.412),35.8 (0.379),38.0 (0.359)
 90 (1.5),26.2 (0.541),33.5 (0.502),38.2 (0.481),42.8 (0.464),45.5 (0.415),47.5 (0.385)
 120 (2.0),26.4 (0.499),45.5 (0.624),58.2 (0.667),70.3 (0.691),95.4 (0.785),114.2 (0.832)
 180 (3.0),36.6 (0.615),53.0 (0.640),63.8 (0.642),74.2 (0.638),126.3 (0.902),165.4 (1.040)
 360 (6.0),33.5 (0.455),53.0 (0.512),65.9 (0.526),78.3 (0.530),121.0 (0.674),153.0 (0.745)
 720 (12.0),34.3 (0.370),59.5 (0.450),76.2 (0.472),92.3 (0.481),156.2 (0.665),204.0 (0.756)
 1080 (18.0),30.3 (0.284),50.8 (0.330),64.3 (0.341),77.3 (0.344),118.3 (0.428),149.0 (0.468)
 1440 (24.0),29.0 (0.246),42.2 (0.247),50.9 (0.242),59.3 (0.235),84.3 (0.272),103.0 (0.288)
 2160 (36.0),16.9 (0.126),29.7 (0.150),38.1 (0.155),46.2 (0.157),75.0 (0.206),96.6 (0.230)
 2880 (48.0),5.4 (0.037),25.0 (0.115),38.0 (0.140),50.4 (0.154),70.7 (0.175),85.9 (0.185)
 4320 (72.0),0.3 (0.002),15.3 (0.063),25.2 (0.082),34.8 (0.094),53.0 (0.116),66.6 (0.126)

[PREBURST75_META]

Time Accessed,04 April 2022 01:44PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST75]From preburst class

90% Preburst Depths

[PREBURST90]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),86.2 (2.018),84.5 (1.449),83.5 (1.206),82.4 (1.031),103.0 (1.091),118.4 (1.120)
 90 (1.5),81.6 (1.682),120.0 (1.800),145.4 (1.830),169.8 (1.840),213.9 (1.950),247.0 (2.001)
 120 (2.0),63.5 (1.201),126.4 (1.732),168.0 (1.926),208.0 (2.045),235.9 (1.942),256.8 (1.872)
 180 (3.0),86.7 (1.455),154.7 (1.868),199.7 (2.008),242.9 (2.086),308.7 (2.205),358.0 (2.252)
 360 (6.0),97.5 (1.324),137.5 (1.326),164.0 (1.307),189.4 (1.280),226.3 (1.259),254.0 (1.236)
 720 (12.0),93.3 (1.006),133.6 (1.009),160.3 (0.993),185.9 (0.970),243.3 (1.036),286.3 (1.061)
 1080 (18.0),73.2 (0.687),113.6 (0.739),140.4 (0.744),166.1 (0.739),201.6 (0.730),228.3 (0.717)
 1440 (24.0),60.1 (0.512),95.8 (0.560),119.5 (0.567),142.2 (0.564),187.8 (0.605),222.0 (0.621)
 2160 (36.0),39.3 (0.292),85.9 (0.434),116.7 (0.476),146.3 (0.496),160.6 (0.442),171.3 (0.409)
 2880 (48.0),30.6 (0.209),88.5 (0.407),126.8 (0.468),163.6 (0.500),192.6 (0.477),214.3 (0.461)
 4320 (72.0),36.1 (0.220),56.5 (0.231),70.0 (0.229),83.0 (0.223),100.9 (0.220),114.3 (0.217)

[PREBURST90_META]

Time Accessed,04 April 2022 01:44PM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST90]From preburst class

Interim Climate Change Factors

[CCF]

,RCP 4.5,RCP6,RCP 8.5

2030,0.869 (4.3%),0.783 (3.9%),0.983 (4.9%)

2040,1.057 (5.3%),1.014 (5.1%),1.349 (6.8%)

2050,1.272 (6.4%),1.236 (6.2%),1.773 (9.0%)

2060,1.488 (7.5%),1.458 (7.4%),2.237 (11.5%)

2070,1.676 (8.5%),1.691 (8.6%),2.722 (14.2%)

2080,1.810 (9.2%),1.944 (9.9%),3.209 (16.9%)

2090,1.862 (9.5%),2.227 (11.5%),3.679 (19.7%)

[CCF_META]

Time Accessed,04 April 2022 01:44PM

Version,2019_v1

Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

[END_CCF]

[ENDTXT]

ReportID	Duration	Energy	Angle	APD	Comments
3025	5:50	43.93	50.71	50.71	5:50
3026	5:50	43.93	50.71	50.71	5:50
3027	5:50	43.93	50.71	50.71	5:50
3028	5:50	43.93	50.71	50.71	5:50
3029	5:50	43.93	50.71	50.71	5:50
3030	5:50	43.93	50.71	50.71	5:50
3031	5:50	43.93	50.71	50.71	5:50
3032	5:50	43.93	50.71	50.71	5:50
3033	5:50	43.93	50.71	50.71	5:50
3034	5:50	43.93	50.71	50.71	5:50
3035	5:50	43.93	50.71	50.71	5:50
3036	5:50	43.93	50.71	50.71	5:50
3037	5:50	43.93	50.71	50.71	5:50
3038	5:50	43.93	50.71	50.71	5:50
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1324	90	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1325	91	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1326	92	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1327	93	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1328	94	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1329	95	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1330	96	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1331	97	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1332	98	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1333	99	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1334	100	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1335	101	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1336	102	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1337	103	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1338	104	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1339	105	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1340	106	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1341	107	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1342	108	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1343	109	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1344	110	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1345	111	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1346	112	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1347	113	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1348	114	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1349	115	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1350	116	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1351	117	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1352	118	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1353	119	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1354	120	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1355	121	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1356	122	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1357	123	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1358	124	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1359	125	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1360	126	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1361	127	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1362	128	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1363	129	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1364	130	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1365	131	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1366	132	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1367	133	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1368	134	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1369	135	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1370	136	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1371	137	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1372	138	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1373	139	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1374	140	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1375	141	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1376	142	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1377	143	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1378	144	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1379	145	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1380	146	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1381	147	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1382	148	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1383	149	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1384	150	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1385	151	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1386	152	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1387	153	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1388	154	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1389	155	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1390	156	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1391	157	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1392	158	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1393	159	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.27	2.84	2.75	273
1394	160	15400	4.48	2.65	2945	8.88	4.22	11508	4.53	3.78	2.75	8.95	8.53	3.05	2.			

9051	9052	9053	9054	9055	9056	9057	9058	9059	9060	9061	9062	9063	9064	9065	9066	9067	9068	9069	9070	9071	9072	9073	9074	9075	9076	9077	9078	9079	9080	9081	9082	9083	9084	9085	9086	9087	9088	9089	9090	9091	9092	9093	9094	9095	9096	9097	9098	9099	9100	9101	9102	9103	9104	9105	9106	9107	9108	9109	9110	9111	9112	9113	9114	9115	9116	9117	9118	9119	9120	9121	9122	9123	9124	9125	9126	9127	9128	9129	9130	9131	9132	9133	9134	9135	9136	9137	9138	9139	9140	9141	9142	9143	9144	9145	9146	9147	9148	9149	9150	9151	9152	9153	9154	9155	9156	9157	9158	9159	9160	9161	9162	9163	9164	9165	9166	9167	9168	9169	9170	9171	9172	9173	9174	9175	9176	9177	9178	9179	9180	9181	9182	9183	9184	9185	9186	9187	9188	9189	9190	9191	9192	9193	9194	9195	9196	9197	9198	9199	9200	9201	9202	9203	9204	9205	9206	9207	9208	9209	9210	9211	9212	9213	9214	9215	9216	9217	9218	9219	9220	9221	9222	9223	9224	9225	9226	9227	9228	9229	9230	9231	9232	9233	9234	9235	9236	9237	9238	9239	9240	9241	9242	9243	9244	9245	9246	9247	9248	9249	9250	9251	9252	9253	9254	9255	9256	9257	9258	9259	9260	9261	9262	9263	9264	9265	9266	9267	9268	9269	9270	9271	9272	9273	9274	9275	9276	9277	9278	9279	9280	9281	9282	9283	9284	9285	9286	9287	9288	9289	9290	9291	9292	9293	9294	9295	9296	9297	9298	9299	9300	9301	9302	9303	9304	9305	9306	9307	9308	9309	9310	9311	9312	9313	9314	9315	9316	9317	9318	9319	9320	9321	9322	9323	9324	9325	9326	9327	9328	9329	9330	9331	9332	9333	9334	9335	9336	9337	9338	9339	9340	9341	9342	9343	9344	9345	9346	9347	9348	9349	9350	9351	9352	9353	9354	9355	9356	9357	9358	9359	9360	9361	9362	9363	9364	9365	9366	9367	9368	9369	9370	9371	9372	9373	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396	9397	9398	9399	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9410	9411	9412	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425	9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438	9439	9440	9441	9442	9443	9444	9445	9446	9447	9448	9449	9450	9451	9452	9453	9454	9455	9456	9457	9458	9459	9460	9461	9462	9463	9464	9465	9466	9467	9468	9469	9470	9471	9472	9473	9474	9475	9476	9477	9478	9479	9480	9481	9482	9483	9484	9485	9486	9487	9488	9489	9490	9491	9492	9493	9494	9495	9496	9497	9498	9499	9500	9501	9502	9503	9504	9505
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[illegible]

Appendix B – Stormwater Management Drawings

Appendix C – Pre-Development Monte-Carlo Outputs

Summary of Runs for Critical Duration Analysis

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Peak 01: Calculated hydrograph,

| AEP (1:Y) | 10 min | 15 min | 20 min | 25 min | 30 min | 45 min | 1 hour | 1.5 hour | 2 hour | 3 hour | 4.5 hour | 6 hour | 9 hour | 12 hour | 18 hour | 24 hour | 30 hour | 36 hour | 48 hour | 72 hour | 96 hour | 120 hour | 144 hour | 168 hour | Max   | T crit  |
|-----------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|----------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|-------|---------|
| 1         | 0      | 0      | 0      | 0      | 0      | 0      | 0.01   | 0.05     | 0      | 0.09   | 0.08     | 0.09   | 0.08   | 0.05    | 0.04    | 0.04    | 0       | 0       | 0.05    | 0       | 0       | 0        | 0        | 0        | 0.086 | 6 hours |
| 2         | 0      | 0      | 0      | 0      | 0      | 0.03   | 0.1    | 0.12     | 0.14   | 0.13   | 0.14     | 0.12   | 0.11   | 0.08    | 0.07    | 0.06    | 0.02    | 0.02    | 0.06    | 0       | 0.02    | 0.02     | 0        | 0.01     | 0.138 | 2 hours |
| 5         | 0.01   | 0.13   | 0.22   | 0.24   | 0.3    | 0.29   | 0.35   | 0.33     | 0.29   | 0.25   | 0.24     | 0.19   | 0.2    | 0.17    | 0.13    | 0.13    | 0.09    | 0.09    | 0.1     | 0.03    | 0.07    | 0.07     | 0.07     | 0.06     | 0.345 | 1 hours |
| 10        | 0.16   | 0.27   | 0.37   | 0.4    | 0.41   | 0.42   | 0.45   | 0.42     | 0.41   | 0.32   | 0.29     | 0.28   | 0.25   | 0.24    | 0.18    | 0.17    | 0.12    | 0.12    | 0.14    | 0.1     | 0.1     | 0.1      | 0.1      | 0.09     | 0.448 | 1 hours |
| 20        | 0.26   | 0.41   | 0.49   | 0.51   | 0.58   | 0.56   | 0.54   | 0.5      | 0.5    | 0.4    | 0.36     | 0.36   | 0.29   | 0.29    | 0.21    | 0.21    | 0.17    | 0.15    | 0.2     | 0.13    | 0.13    | 0.15     | 0.14     | 0.11     | 0.581 | 30 mins |
| 50        | 0.41   | 0.54   | 0.68   | 0.7    | 0.75   | 0.7    | 0.72   | 0.63     | 0.59   | 0.48   | 0.47     | 0.42   | 0.37   | 0.35    | 0.26    | 0.28    | 0.21    | 0.19    | 0.28    | 0.17    | 0.16    | 0.19     | 0.19     | 0.14     | 0.751 | 30 mins |
| 100       | 0.54   | 0.71   | 0.8    | 0.86   | 0.87   | 0.81   | 0.84   | 0.7      | 0.65   | 0.52   | 0.54     | 0.51   | 0.48   | 0.43    | 0.3     | 0.33    | 0.22    | 0.22    | 0.33    | 0.2     | 0.19    | 0.25     | 0.23     | 0.17     | 0.869 | 30 mins |

## Appendix D – Untreated Post-Development Monte-Carlo Outputs

### Summary of Runs for Critical Duration Analysis

Peak 01: Calculated hydrograph,

| AEP<br>(1:Y) | 10 min | 15 min | 20 min | 25 min | 30 min | 45 min | 1 hour | 1.5 hour | 2 hour | 3 hour | 4.5 hour | 6 hour | 9 hour | 12 hour | 18 hour | 24 hour | 30 hour | 36 hour | 48 hour | 72 hour | 96 hour | 120 hour | 144 hour | 168 hour | Max   | T crit |
|--------------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|----------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|-------|--------|
| 1            | 0.31   | 0.36   | 0.39   | 0.38   | 0.38   | 0.34   | 0.32   | 0.29     | 0.26   | 0.21   | 0.18     | 0.14   | 0.13   | 0.09    | 0.08    | 0.08    | 0.03    | 0.05    | 0       | 0       | 0       | 0.01     | 0.02     | 0        | 0.387 | 20min  |
| 2            | 0.35   | 0.4    | 0.44   | 0.44   | 0.44   | 0.39   | 0.37   | 0.34     | 0.29   | 0.24   | 0.21     | 0.17   | 0.16   | 0.12    | 0.09    | 0.09    | 0.05    | 0.06    | 0       | 0       | 0       | 0.03     | 0.04     | 0        | 0.442 | 20min  |
| 5            | 0.49   | 0.58   | 0.62   | 0.59   | 0.62   | 0.55   | 0.53   | 0.48     | 0.42   | 0.37   | 0.3      | 0.25   | 0.24   | 0.21    | 0.15    | 0.15    | 0.11    | 0.1     | 0.12    | 0.07    | 0.08    | 0.09     | 0.09     | 0.07     | 0.621 | 30min  |
| 10           | 0.59   | 0.69   | 0.75   | 0.73   | 0.74   | 0.66   | 0.62   | 0.56     | 0.52   | 0.43   | 0.37     | 0.33   | 0.28   | 0.26    | 0.2     | 0.19    | 0.14    | 0.13    | 0.15    | 0.11    | 0.11    | 0.12     | 0.12     | 0.1      | 0.753 | 20min  |
| 20           | 0.71   | 0.82   | 0.87   | 0.86   | 0.85   | 0.76   | 0.72   | 0.64     | 0.58   | 0.48   | 0.44     | 0.41   | 0.32   | 0.33    | 0.24    | 0.24    | 0.18    | 0.16    | 0.21    | 0.14    | 0.14    | 0.16     | 0.16     | 0.12     | 0.873 | 20min  |
| 50           | 0.86   | 1      | 1.03   | 1.07   | 0.99   | 0.94   | 0.88   | 0.73     | 0.67   | 0.58   | 0.55     | 0.5    | 0.42   | 0.39    | 0.28    | 0.33    | 0.22    | 0.21    | 0.29    | 0.19    | 0.18    | 0.21     | 0.21     | 0.15     | 1.073 | 25min  |
| 100          | 0.97   | 1.14   | 1.16   | 1.19   | 1.09   | 1.09   | 0.99   | 0.81     | 0.73   | 0.65   | 0.61     | 0.6    | 0.57   | 0.52    | 0.31    | 0.38    | 0.24    | 0.24    | 0.32    | 0.22    | 0.2     | 0.27     | 0.26     | 0.17     | 1.19  | 25min  |