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Engineering design and drafting services
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Site Based Stormwater Management Plan

for the

Multi-Unit Residential Development

at

5-9 FOLKESTONE STREET, BOWEN HILLS

for

MELTHORN PTY LTD

Project No: WCD-044

Revision: B

Date: 2 December 2014

RPEQ Certification

This document has been reviewed and approved by the following appropriately qualified and experienced Registered Professional Engineer of Queensland (RPEQ).

.....

Thomas Gabele (RPEQ No.5442)

On behalf of WC Designs
69 Spence Street
Mount Gravatt East QLD 4122
Ph: 0412 469 686

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REVISION	AUTHOR	DESCRIPTION	DATE	APPROVED
A	WC	For Review (Draft)	27/11/2014	WC
B	WC	For Approval (Final)	02/12/2014	WC

Table of Contents

Appendices

1. Executive Summary

1.1 Introduction

The following Site Based Stormwater Management Plan (SBSMP) has been prepared on behalf of Melthorn Pty Ltd for the proposed residential development of 5-9 Folkestone Street, Bowen Hills. The proposed development shall include 37, one, two and three bedroom apartments across 8 levels. A total of 38 car parking spaces are provided including visitor spaces across the ground and basement levels. Access is provided via Folkestone Street to the North.

The existing topography varies between RL.10.12m AHD to RL.4.94m AHD at Folkestone Street as shown via the detail survey prepared by Survey Mark and referenced in Appendix A. The three existing residential allotments each contain single detached dwellings fronting Folkestone Street as shown in the Aerial Imagery contained in Appendix B.

Refer to Figures 1.1 and 1.2 below showing Street Locality and existing Aerial View of the proposed development site.

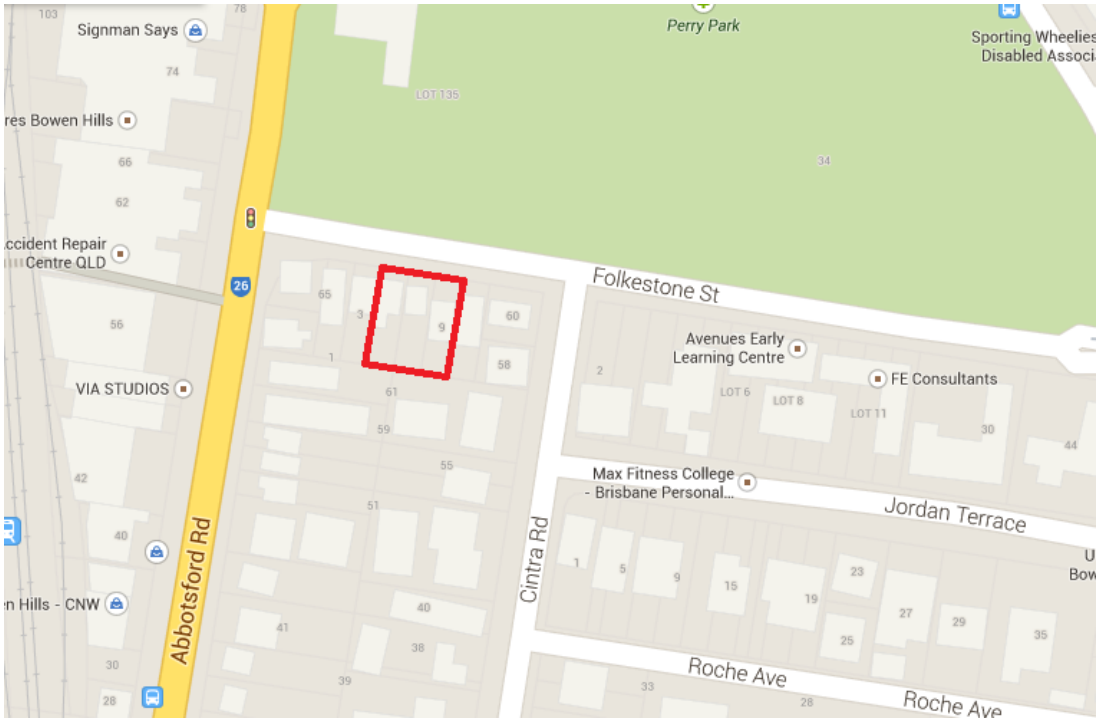


Figure 1.1 ~ Locality Plan

Figure 1.2 ~ Aerial View

1.2 Objectives

The objective of this report is to address the stormwater quality and quantity requirements of the Queensland Urban Drainage Manual (QUDM), Brisbane City Council (BCC), the South East Queensland Regional Plan 2009-2031 Implementation Guideline No.7, the Environmental Protection Act 1994 and its associated Environmental Protection (Water) Policy 2009.

The aim of this Conceptual Stormwater Management Plan is to identify any stormwater detention requirements (if required) and an appropriate level of quality improvement for the treatable flow (if required) being Q_{3Month} (as determined by BCC) to a level that achieved the Water Quality Objectives as deemed required.

1.3 Development Details

Site Address:	5 Folkestone Street, Bowen Hills
Property Description:	Lots 5, 6, and 7 RP10094
	Parish of North Brisbane
	County of Stanley
Site Area:	1094m^2
Proposed Use:	Residential development
Local Authority:	Brisbane City Council (BCC)

1.4 Existing Infrastructure

The site generally falls from the southeast to the northwest with elevations ranging RL.10.12m AHD to RL.4.94m AHD. There is currently a BCC gully pit located along the frontage of 1 Folkestone Street which connects to a larger system in Abbotsford Road that ultimately drains to a 750mm stormwater pipe draining to the northeast and traversing Perry Park. There are no other systems located along the frontage of the property. Refer Appendix C for extracts from the Brisbane City Council eBiMap mapping showing available infrastructure within the adjoining streets.

The Brisbane City Council, Floodwise Property Report as included in Appendix D provides a summary of flood information for this property and defines a minimum habitable floor level as RL.3.2m AHD while the existing natural ground level is at RL.4.9m AHD. Further clarification must be determined around the Defined Flood Level for the site to ensure appropriate flood immunity is provided to finished floor levels.

It should also be noted that Council's Flood Awareness Map for the Bowen Hills area as included in Appendix D (extract included below) represents no direct risk of flooding of the subject site

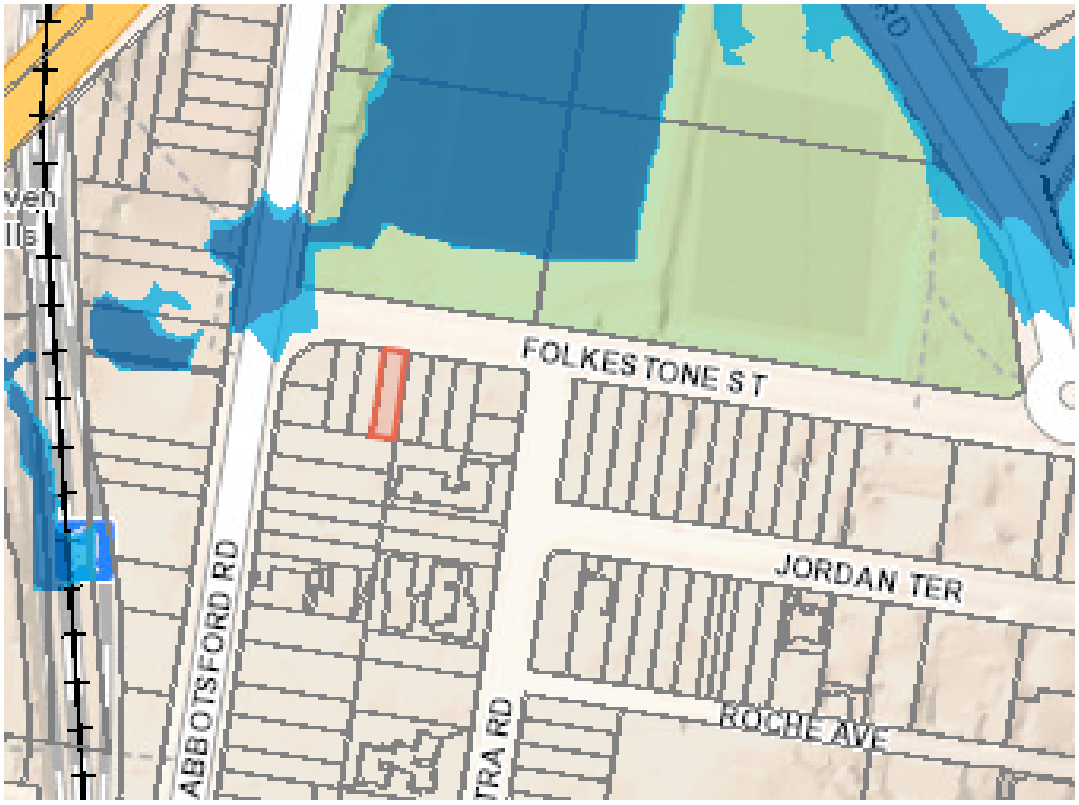


Figure 1.3 ~ Flood Awareness Map Extract

2. Stormwater Quality

2.1 Water Quality Objectives

The Department of State Development, Infrastructure and Planning, "State Planning Policy (SPP), July 2014" defines development of state interest for receiving waters only when the development application triggers any of the following:

1. *A material change of use for urban purposes that involves a land area greater than 2500m² ->* Not Applicable *or*
2. *Reconfiguring a lot for urban purposes that involves a land area of greater than 2500m² and will result in six or more lots, ->* Not Applicable *or*
3. *Operational works for urban purposes that involve disturbing more than 2500m² of land ->* Not Applicable*.*

Introduction of water quality improvement devices are therefore not required under the SPP.

Furthermore, the Brisbane City Council, Subdivision and Development Guidelines, Part C, Chapter 3: Site Based Stormwater Management Plans, defines the risk category characteristics for assessment against proposed development as follows:

1. *Any development located in a defined waterway or Brisbane River corridor or wetland as indicated by BCC Planning Scheme Maps ->* Not Applicable*.*
2. *Multi-unit dwelling or commercial uses with the impermeable surface area greater than 2500m² ->* Not Applicable*.*
3. *Subdivisions where greater than 6 lots are created ->* Not Applicable*.*
4. *Industrial activities which are not impact assessable and have at least 1000m² in uncovered storage or working spaces ->* Not Applicable*.*
5. *Industrial activities that are impact assessable ->* Not Applicable*.*
6. *Uncovered carparks with at least 100 spaces ->* Not Applicable*.*

The development is therefore categorized as "Low Risk" under the BCC Guidelines which requires best practice strategies for pollutant identification during the construction and operational phases in order to be deemed to satisfy the Water Quality Guidelines.

2.2 Proposed Development

Further water quality analysis and "Pollutant Export Modelling" is not deemed to be required due to the site categorized as "Low Risk". Water quality measures shall therefore be described as *(but not limited to)* a requirement to incorporate best practice pollutant identification and mitigation strategies.

3. Stormwater Quantity

3.1 Water Quantity Objectives

Water quantity objectives for the proposed development have been determined in accordance with the Brisbane City Council, Subdivision and Development Guidelines, Part C, Chapter 3: Site Based Stormwater Management Plans and the Queensland Urban Drainage Manual 2013 (QUDM) as follows:

- "Lawful Point of Discharge" being a proposed drainage system in Folkestone Street in accordance with the QUDM, Section 3.4
- No increase in flows between pre and post development works, up to and including the 50 year storm events; and
- No adverse impact on adjoining or downstream properties.

3.2 Methodology

In order to determine the stormwater flows, a Runoff Routing Model (XPRafts) was developed for the site catchments. The development architectural layout plans as prepared by Wiltshire Stevens Architecture are attached as Appendix A.

The proposed development will not alter the stormwater catchment significantly. The impervious area of the developed site will increase due to the existing site consisting primarily of the detached dwellings, carport, hardstand and open space with scattered trees. As such, it is expected that the increase in impervious area will result in a higher runoff from the developed site however, the BCC requires that the existing volume of stormwater discharge be maintained post development.

The Brisbane City Council development guidelines define the design parameters for the minor and major storm events for any given project based on the size and use of the proposed development. The proposed development minor storm event has been taken as the Q10 ARI storm event while the major is Q50 ARI storm event. Both the minor and major storm events have therefore been modelled for the following durations:

Storm 1	~	15 minutes;	Storm 2	~	20 minutes;
Storm 3	~	25 minutes;	Storm 4	~	30 minutes;
Storm 5	~	45 minutes;	Storm 6	~	60 minutes
Storm 7	~	90 minutes;	Storm 8	~	120 minutes;
Storm 9	~	180 minutes;	Storm 10	~	270 minutes;
Storm 11	~	360 minutes;	Storm 12	~	540 minutes; and
Storm 13	~	540 minutes			

The above mentioned storms can be related to the output hydrographs included within Appendices E and F for the Pre and Post Development flows respectively.

3.3 Pre Development Scenario

Table 3.1 below outlines the calculations, methodology and input parameters used to undertake the pre-development hydrologic modelling in XPRafts.

Table 3.1 ~ Pre-development XPRafts Input Parameters

Parameter	Value	Units	Source
IFD Chart	Brisbane	N/A	Bureau of Meteorology
IFD Coefficients	Brisbane	N/A	Bureau of Meteorology
Zone	3	N/A	AR&R, Volume 1, Book 2
Impervious Initial Loss / Continuing Loss *	1.0 / 0	mm	AR&R, Volume 1, Book 5
Pervious Initial Loss / Continuing Loss *	10 / 2.5	mm	AR&R, Volume 1, Book 5
Impervious Catchment Mannings	0.025	N/A	Conc / Asphalt
Pervious Catchment Mannings	0.045	N/A	Grass
Pervious Catchment Area	0.0600	ha	Survey Plan
Impervious Catchment Area	0.0493	ha	Survey Plan
Vectored Slope	10.8	%	Survey Plan

* The Initial and Continuing Loss models are within the specified Australian Rainfall and Runoff (AR&R) ranges and have been calibrated to the results obtained from the rational method calculations.

The Rational Method adopted a C10 coefficient of runoff of 0.82 for the pre-development catchment based upon the type of development and minimum C10 values as stated within the BCC development guidelines.

Table 3.2 below outlines the results of the hydrological modelling. Refer XPRafts outputs included in Appendix E for further details.

Table 3.2 ~ Pre-development Peak Flow Rates

ARI (Years)	Value (m3/s)
Q10	0.061
Q50	0.076

The accuracy of the XPRafts model has been compared against flow rates as determined using the Rational Method calculations for each storm event. The peak event was assumed to be equal to the time of concentration for the catchment. Table 3.3 below shows the rational method values calculated and Appendix G includes the calculations.

Table 3.3 ~ Pre-development Rational Method Flow Rates

ARI (Years)	Value (m3/s)
Q10	0.054
Q50	0.084

Comparison of the XPRafts Model results and the Rational Method Calculations results show a reasonable level of correlation for the storm events and as such, the XPRafts Model is considered satisfactory for this investigation.

3.4 Post Development Scenario

Table 3.4 below outlines the calculations, methodology and input parameters used to undertake the post-development hydrologic modelling in XPRafts.

Table 3.4 ~ Post-development XPRafts Input Parameters

Parameter	Value	Units	Source
IFD Chart	Brisbane	N/A	Bureau of Meteorology
IFD Coefficients	Brisbane	N/A	Bureau of Meteorology
Zone	3	N/A	AR&R, Volume 1, Book 2
Impervious Initial Loss / Continuing Loss *	1.0 / 0	mm	AR&R, Volume 1, Book 5
Pervious Initial Loss / Continuing Loss *	10 / 2.5	mm	AR&R, Volume 1, Book 5
Impervious Catchment Mannings	0.025	N/A	Conc / Asphalt
Pervious Catchment Mannings	0.045	N/A	Grass
Pervious Catchment Area	0.0265	ha	Survey Plan
Impervious Catchment Area	0.0828	ha	Survey Plan
Vectored Slope	10.8	%	Survey Plan

* The Initial and Continuing Loss models are within the specified Australian Rainfall and Runoff (AR&R) ranges and have been calibrated to the results obtained from the rational method calculations.

Table 3.5 below outlines the results of the hydrological modelling. Refer XPRafts outputs included in Appendix F for further details.

Table 3.5 ~ Post-development Peak Flow Rates

ARI (Years)	XP Rafts Value (m3/s)	Increase compared to Pre Development XP Rafts Values
Q10	0.066	8.2%
Q50	0.083	9.2%

Comparison of the pre and post development flows shows an increase in discharge therefore it is necessary to detain stormwater within the site before discharging to the external drainage network.

3.5 Detention Requirements

It is evident based on the hydrological modelling that the proposed development will cause an increase in the peak storm flows. Therefore in order to comply with BCC and QUDM guidelines it will be necessary to incorporate a stormwater detention system into the development.

As the roof water connections (Gutters and downpipes) are generally sized for the 20-year ARI storm event (Q20), all flows exceeding the 20-year ARI flow (or equivalent to 46 l/s) has been modelled to bypass the detention tank.

The detention system proposed is designed to allow all minor storm events for the roof and hardstand areas of the site to be discharged to a proposed manhole and pipe network in Folkestone Street and the Folkestone Street road reserve. The major event will be detained to pre-developed flow rates and all flows exceeding the minor system will be discharged via overland flow, as currently occurs.

It is proposed to provide a detention tank with a gravity discharge to a proposed manhole adjacent the front property boundary. The detention tank will also have a high flow pipe connected to a surcharge on the front boundary to allow the major flows to discharge via overland flow.

An indicative detention tank of the following properties has been modelled:

- Total detention volume of 10m^3
- Approximate base area of 5m^2
- 120mm diameter Orifice Plate over a 150mm discharge pipe for the low level outlet; and
- High level outlet 150mm discharge pipe located at the top of the tank approximately 1.8m above the invert of the low flow outlet.

The stormwater detention system will attenuate all design storms up to and including a Q50 storm. Refer the XPRafts Output Data within Appendix F for further details.

Table 3.6 ~ Post-development Mitigated Peak Flow Rates

ARI (Years)	XP Rafts Value (m3/s)
Q10	0.030
Q50	0.039

As Table 3.6 illustrates the proposed detention tank is adequate to provide attenuation to all development flow up to and including the Q50 ARI storm event and discharge to a proposed stormwater system in Folkestone Street and road reserve.

3.6 Proposed Development (Legal Point of Discharge)

It is proposed to discharge all minor stormwater via a new manhole and pipe system discharging to the existing gully pit to the west of the development in the Folkestone Street road reserve. The major events will be discharged to the Folkestone Street kerb and channel and road reserve, as currently occurs.

The proposed development shall include detention storage to restrict the total discharge from the development site to pre-developed flow prior to discharging to the proposed system as detailed above. A rainwater detention tank as described above shall be incorporated within the bounds of the development site to detain water prior to release to the proposed system.

4. Conclusion and Recommendations

The aim of this conceptual SBSMP is to identify the need (if any) for water quality improvement measures and stormwater detention requirements.

Assessment of the development against the State Planning Policy and the Brisbane City Council Development Guidelines determined that water quality measures shall be limited to incorporation of best practice pollutant identification and mitigation strategies only. Therefore formal pollutant modelling and incorporation of water treatment devices is not required.

Stormwater quantity was modelled using the Runoff Routing model (XPRafts) program. The development will increase the impervious area of the site and hence the calculated runoff will also be increased. In accordance with the BCC and QUDM guidelines, stormwater detention will be required to restrict post development runoff to pre-development rates. Accordingly, an indicative detention basin volume of 10m^3 is required to contain the increased flow and allow discharge to the proposed system in Folkestone Street and the road reserve. Please note that further design of the detention tank will be required during the detailed design phase.

Based upon the above mentioned comments, we believe that incorporation of the recommendations of this report will result in a development that satisfies BCC's requirements for stormwater quality and quantity.

5. References

Brisbane City Council (BCC) (2000). Stormwater Quality Best Management Practices.

Brisbane City Council, 2001. Guidelines – Sediment Basin Design, Construction and Maintenance.

Institute of Public Works Engineering Australia (2013) "Queensland Urban Drainage Design Manual (QUDM)", Third Edition

Brisbane City Council (BCC) (2008). Subdivision and Development Guidelines, 2008. City Policy and Strategy Division, Brisbane City Council.

Department of State Development, Infrastructure and Planning, "State Planning Policy, July 2014"

Appendix A

Proposed Development

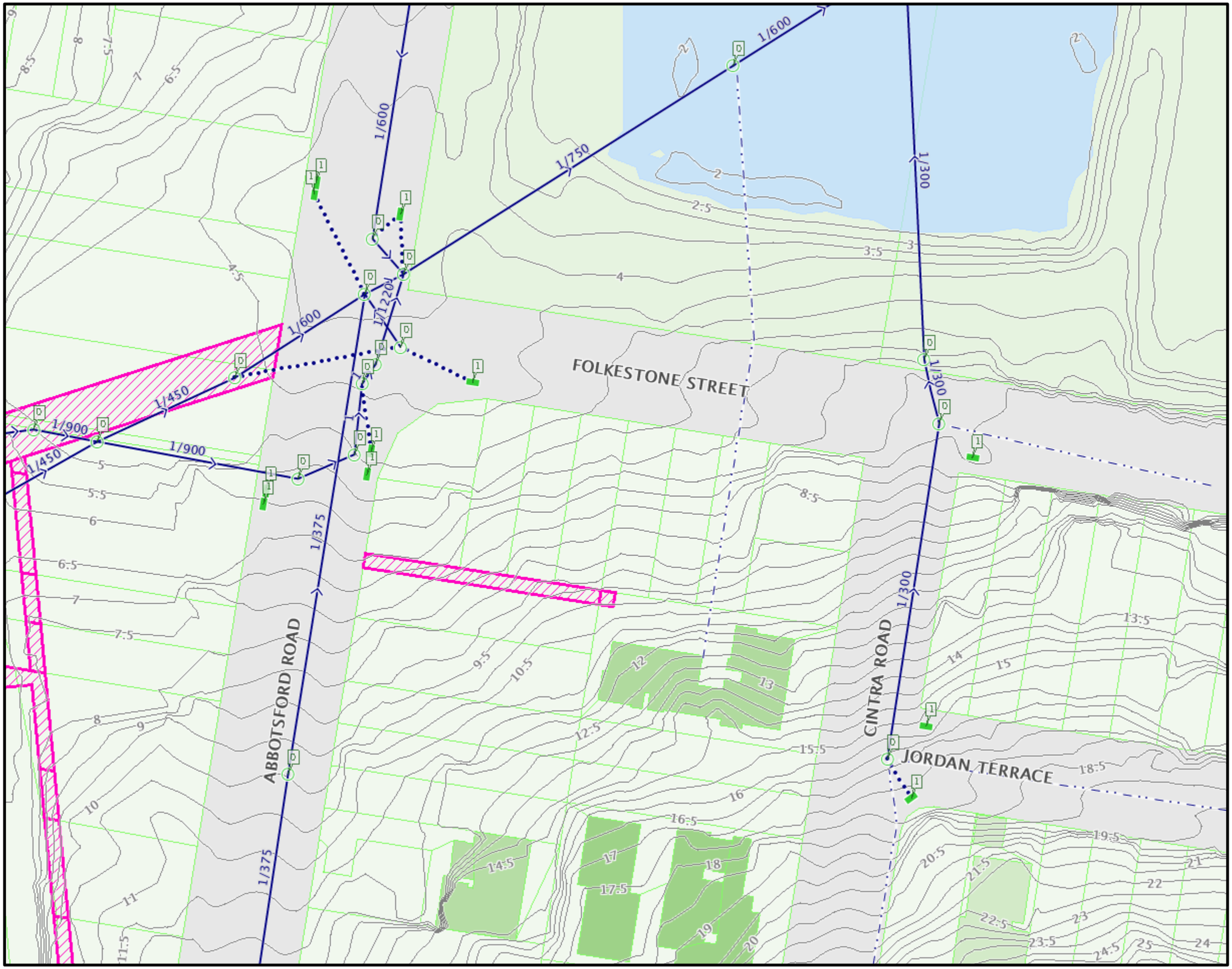
Appendix B

Aerial Imagery

File Name: Aerial Image.doc
Revision: B

Appendix C

Brisbane City Council eBiMap Extracts



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503,661 N 504,050

6,964,240

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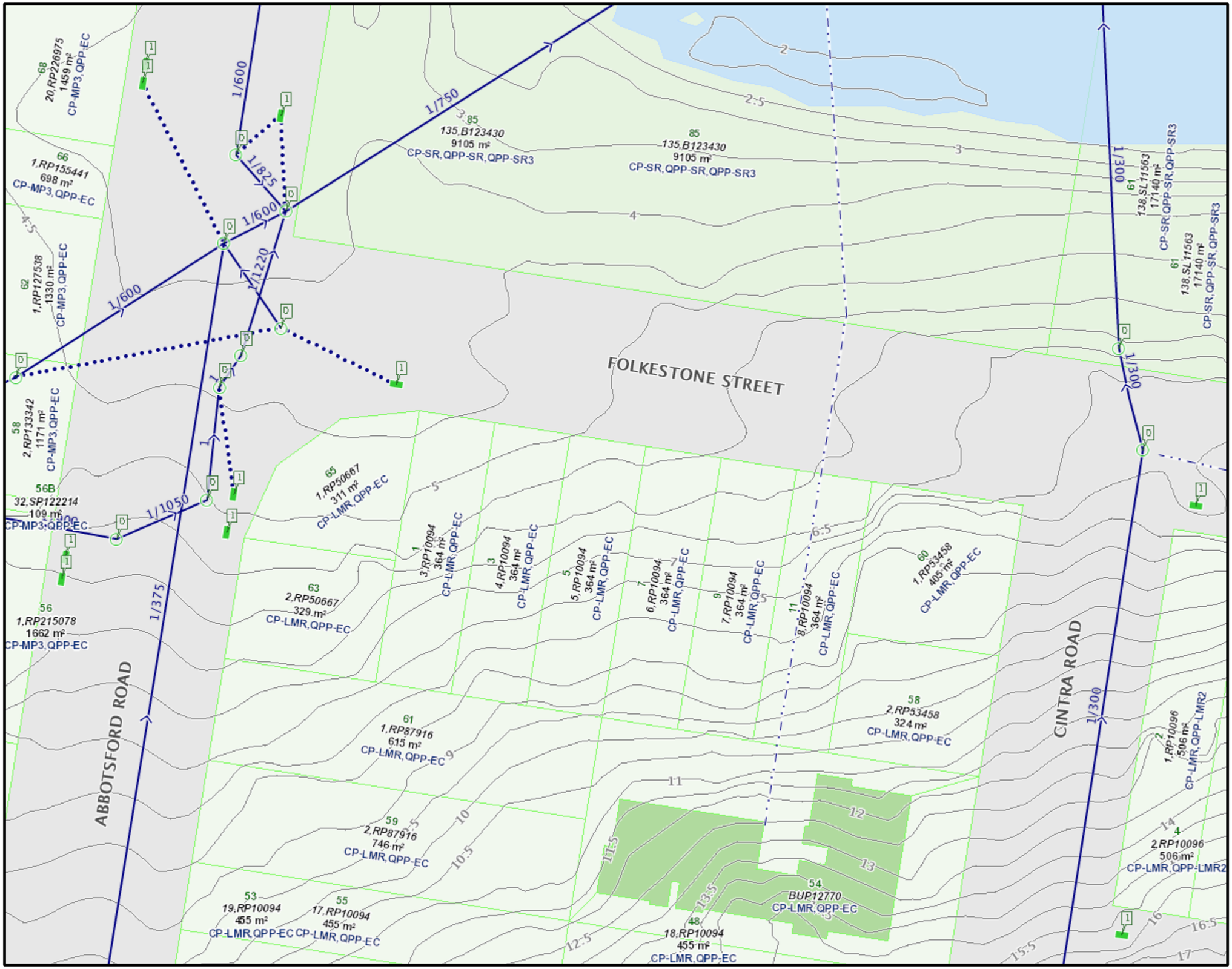
Caution: This map may contain the locations of abandoned underground asbestos pipes. Council gives no warranty to the completeness or accuracy of these records. Appropriate care needs to be taken in all cases.

BRISBANE CITY

GDA

Qasco
The spatial data professionals



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Location :

6,964,392
503,758 N 503,950
6,964,296

Disclaimer :

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Appendix D

Brisbane City Council Floodwise Property Report

Brisbane City Council

FloodWise Property Report

Report Reference
3221471
30/11/2014 12:40:12

Dedicated to a better Brisbane

THIS REPORT IS FOR BUILDING AND DEVELOPMENT PURPOSES ONLY

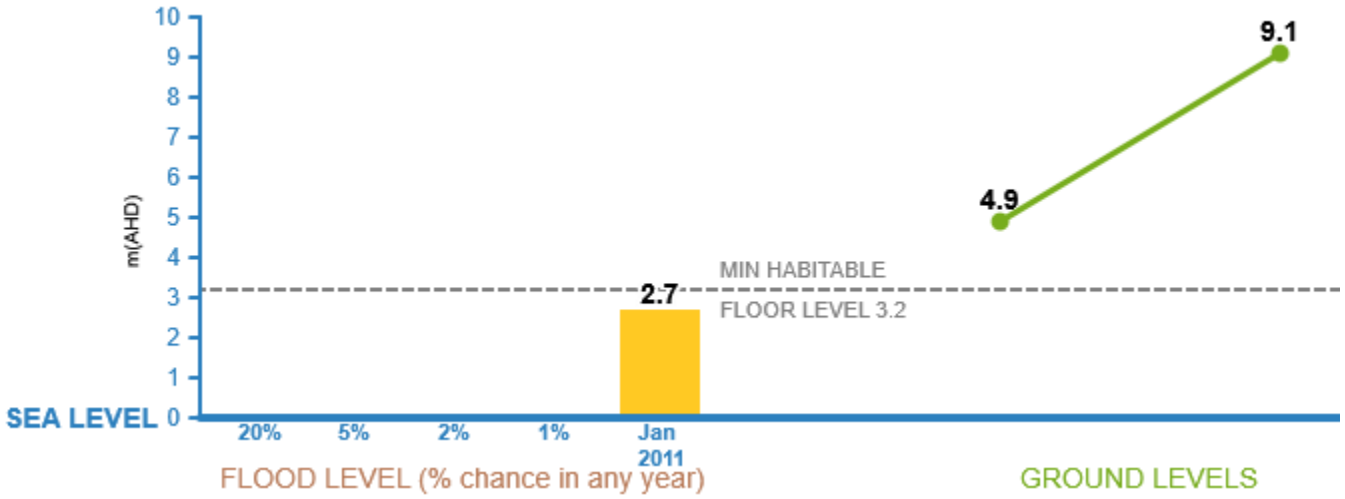
The FloodWise Property Report provides property or lot-based flood information for building and development requirements. This report provides information on estimated flood levels, habitable floor level requirements and more technical information on the four sources of flooding: river, creek / waterway, storm tide and overland flow. Refer to the Useful Definitions section for a glossary of terms.

To find out more about how the contents of this report may affect building or development on this property, please visit www.brisbane.qld.gov.au/planning-building.For more general information about understanding your flood risk and how to prepare your property, family or business for potential flooding visit www.brisbane.qld.gov.au/beprepared

PROPERTY DETAILS:

Address: 5 FOLKESTONE ST, BOWEN HILLS QLD 4006
Lot Details: L.5 RP.10094

FLOOD LEVEL INFORMATION



EXPLANATION

m(AHD) - Metres Australia Height Datum. The level of 0.0m AHD is approximately mean sea level.

Flood Levels - The Flood level bar chart above shows the possible flooding level and percentage chance of that level being reached or exceeded in any year. If an orange bar shows, it is the calculated January 2011 flood level at this address or lot.

Minimum Habitable Floor Level - Applies to residential development only. Please refer to Council's planning scheme to learn how this may affect you. If a property is in an overland flow path, or a large allotment, a minimum habitable floor level cannot be provided. Refer flood and planning development flags below.

Ground Levels- The green line above shows this property's approximate lowest and highest ground levels based on latest available information (2009 airborne laser survey) to Council. If you are building, please confirm with a surveyor.

For further information and definitions please refer to the Useful Definitions page

Brisbane City Council

FloodWise Property Report

Report Reference
3221471
30/11/2014 12:40:12

Dedicated to a better Brisbane

TECHNICAL SUMMARY

This section of the FloodWise Property Report contains more detailed flood information for this property so surveyors, builders, certifiers, architects and engineers can plan and build in accordance with Council's planning scheme. For more information about building and development in Brisbane please visit www.brisbane.qld.gov.au/planning-building or talk to a Development Assessment Planning Information Officer via Council's Contact Centre on (07) 3403 8888.

PROPERTY DETAILS:

Address: 5 FOLKESTONE ST, BOWEN HILLS QLD 4006
Lot Details: L.5 RP.10094

PROPERTY INFORMATION (Summary)

The following table provides a summary of flood information for this property. More detailed flood level information is provided in the following sections of this report.

PROPERTY SUMMARY	LEVEL (mAHD)
Minimum Ground Level	4.9
Maximum Ground Level	9.1
Min Habitable Floor Level	3.2
Residential Flood Level (RFL)	2.7
Residential Flood Level Source	RIVER
Source of Highest Flooding	RIVER

ESTIMATED PEAK FLOODING LEVELS

The table below displays the peak estimated flood levels by probability for this property. Estimated flood level data should be used in conjunction with applicable planning scheme requirements - Refer to Flood Planning Development Information.

Note that the overland flow flooding level maybe higher than the levels below from other sources.

DESCRIPTION	LEVEL (mAHD)	SOURCE
20% AEP	N/A*	
5% AEP	N/A*	
2% AEP	N/A*	
1% AEP	N/A*	
January 2011	2.7	RIVER
RFL	2.7	RIVER

FLOOD PLANNING DEVELOPMENT INFORMATION

This section of the FloodWise Property Report contains information about Council's planning scheme overlays. Overlays identify areas within the planning scheme that reflect distinct themes that may include constrained land and/or areas sensitive to the effects of development.

FLOOD OVERLAY CODE

The Flood overlay code of Council's planning scheme uses the following information to provide guidelines when developing properties. The table below summarises the Flood Planning Areas (FPAs) that apply to this property. Development guidelines for the FPAs are explained in Council's planning scheme, which is available from www.brisbane.qld.gov.au/planning-building.

FLOOD PLANNING AREAS (FPA)		
RIVER	CREEK/WATERWAY	OVERLAND FLOW
FPA5		Not Applicable

COASTAL HAZARD OVERLAY CODE

There are currently no Coastal Hazard Overlays that apply to this property.

Brisbane City Council

FloodWise Property Report

Report Reference
3221471
30/11/2014 12:40:12

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Useful Definitions

Australian Height Datum (AHD) - The reference level for defining ground levels in Australia. The level of 0.0m AHD is approximately mean sea level.

Annual Exceedance Probability (AEP) – The probability of a flood event of a given size occurring in any one year, usually expressed as a percentage annual chance.

Defined Flood Level (DFL) - The DFL for Brisbane River flooding is a level of 3.7m AHD at the Brisbane City Gauge based on a flow of 6,800 m^3/s.

Maximum and Minimum Ground Level – Highest and lowest ground levels on the property based on available ground level information. A Registered Surveyor can confirm exact ground levels.

Minimum Habitable Floor Level – The minimum level in metres AHD at which habitable areas of development (generally including bedrooms, living rooms, kitchen, study, family and rumpus rooms) must be constructed.

Council's Planning Scheme - The City Plan (planning scheme) has been prepared in accordance with the Sustainable Planning Act as a framework for managing development in a way that advances the purpose of the Act. In seeking to achieve this purpose, the planning scheme sets out the Council's intention for future development in the planning scheme area, over the next 20 years.

Residential Flood Level (RFL) – Residential flood level (RFL) for Brisbane River flooding equates to the flood level applicable to the extent of January 2011 floods as depicted by mapping on the Queensland Reconstruction Authority website or the Council's defined flood level (DFL) for the Brisbane River, whichever is higher.

Brisbane City Council's Online Flood Tools

Council provides a number of online flood tools:

- to guide planning and development
- to help residents and businesses understand their flood risk and prepare for flooding.

Planning and Development Online Flood Tools

Council's online flood tools for planning and development purposes include:

- FloodWise Property Report
- Flood Overlay Code

For more information on Council's planning scheme and online flood tools for planning and development:

- phone 07 3403 8888 to talk to a Development Assessment Customer Liaison Officer
- visit www.brisbane.qld.gov.au/planning-building
- visit a Regional Business Centre.

Helping residents and businesses be prepared for flooding

Council has a range of free tools and information to help residents and businesses understand potential flood risks and how to be prepared. This includes:

- Flood Awareness Maps
- Flooding in Brisbane – A Guide for Residents
- Flooding in Brisbane – A Guide for Business
- Early Warning Alert Service. Visit www.brisbane.qld.gov.au/earlywarning to register for email, home phone or SMS severe weather alert updates.

Note: The Flood Awareness Maps show four levels of flood risk from high risk (flooding is very likely to occur) through to very low risk (very rare and extreme flood events). Flooding in the low and very low risk areas has no planning and development requirements and is therefore not reflected in the FloodWise Property Report.

For more information on Council's online flood tools for residents and business:

- Visit www.brisbane.qld.gov.au/beprepared
- Phone (07) 3403 8888.

Brisbane City Council

FloodWise Property Report

Report Reference
3221471

30/11/2014 12:40:12

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Disclaimer

1. Defined Flood Levels and Residential Flood Levels, and the Minimum Habitable Floor Levels are determined from the best available information to Council at the date of issue. These flood levels, for a particular property, may change if more detailed information becomes available or changes are made in the method of calculating flood levels.
2. Council makes no warranty or representation regarding the accuracy or completeness of a FloodWise Property report. Council disclaims any responsibility or liability in relation to the use or reliance by any person on a FloodWise Property Report.

Planning to build or renovate?

For information, guidelines, tools and resources to help you track, plan or apply for your development visit **www.brisbane.qld.gov.au/planning-building**

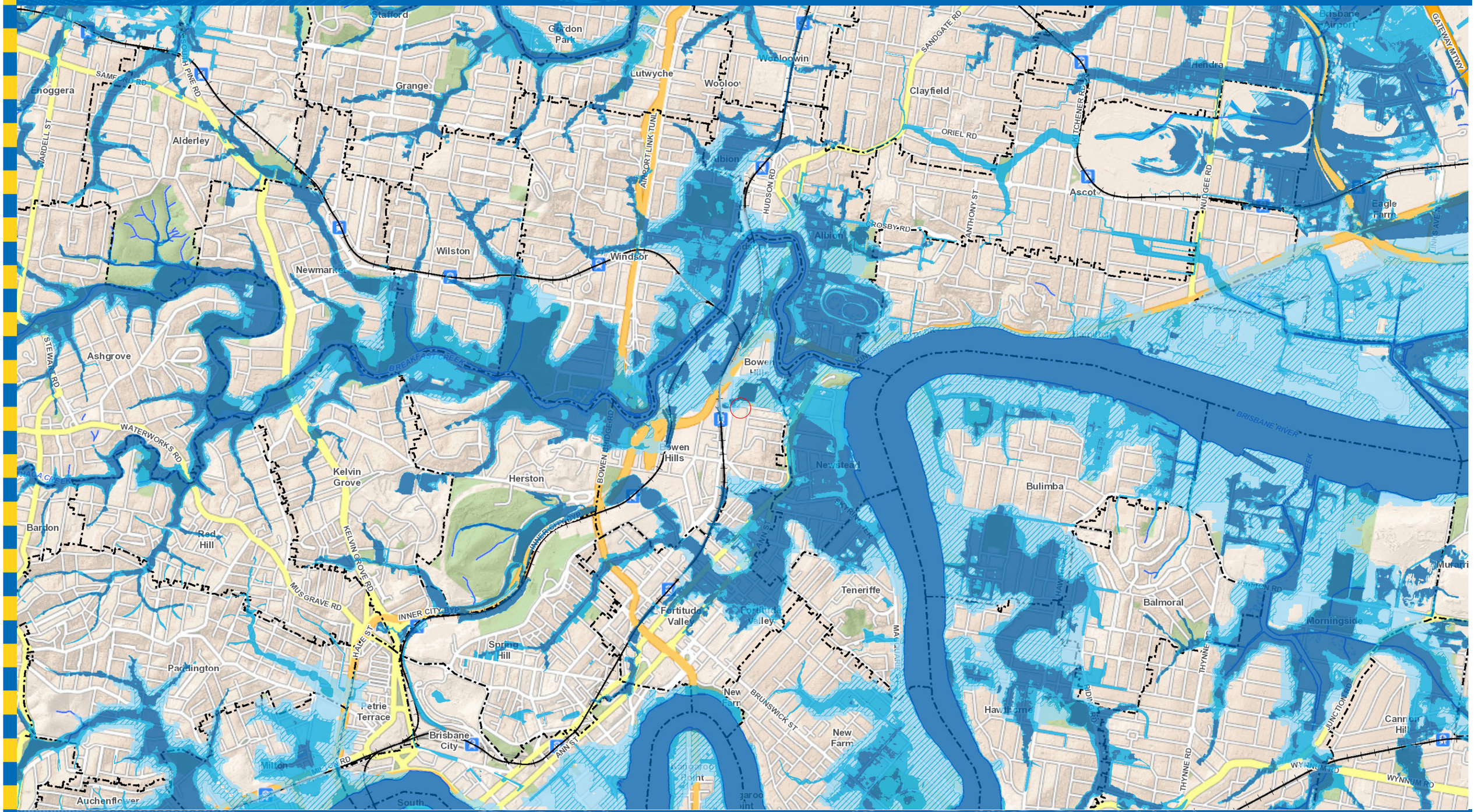
You can also find the Brisbane City Plan 2014 and Neighbourhood Plans as well as other information and training videos to help with your building and development plans.

Dedicated to a better Brisbane

Map produced on 2/12/2014 at 5:02 AM

FLOOD AWARENESS MAP
5 FOLKESTONE ST, BOWEN HILLS (5RP10094)

Be Aware.
Be Prepared.



High Flood Risk
Flooding is almost certain to occur in a high risk area.
Residents and businesses are strongly advised to learn about the flood risk for their property so they can be prepared to help minimise the impact on their home, business and family.

Medium Flood Risk
Flooding is likely to occur in a medium risk area.
Residents and businesses are advised to learn about the flood risk for their property so they can be prepared to help minimise the impact on their home, business and family.

Low Flood Risk
A low flood risk area may experience flooding in a rare flood event.
Flooding is unlikely in a low flood risk area, but may still occur.

Very Low Flood Risk
A very low flood risk area is unlikely to flood except in a very rare or extreme flood event.
Flooding is very unlikely in a very low flood risk area, but may still occur.

Residents and businesses should consider how flooding may affect their local suburb, area or community.

This map uses data produced via computer modelling. The information is for awareness purposes. Please consider that you may need individual professional advice. Council makes no warranty or representation regarding the accuracy or completeness of a Flood Awareness Map and disclaims all liability to any person arising directly or indirectly from using the Flood Awareness Maps.
For flood information relating to building or renovating visit www.brisbane.qld.gov.au/planning-building

0 250 500 750 1,000
Meters

N

Publisher:	Brisbane City Council
Publication Date:	2/12/2014
Reference:	BM084699
Projection:	Map Grid of Australia, Zone 56
Horizontal Datum:	Geodetic Datum of Australia

Learn more about how to plan for and respond to flood risks at www.brisbane.qld.gov.au/beprepared

How to prepare for flooding

Council is working hard to reduce the impact of flooding but we all have a responsibility to understand our flood risk and how to be better prepared to minimise the impact on our homes and businesses. **Once you have used Council's Flood Awareness Map to identify the flood risk for your property, use the tips in this table to put a plan in place for your home and family.**

● strongly advised ● advised

		Flood Risk			
		High	Medium	Low	Very low
Brisbane's weather Understand Brisbane's climate and weather patterns	• Sign up for Council's Severe Weather Early Warning Alert Service. **www.brisbane.qld.gov.au/earlywarning**.	●	●	●	●
	• Pay attention to radio, television and online weather updates.	●	●	●	●
	• Visit **www.bom.gov.au** for the latest weather updates.	●	●	●	●
Flooding and your property Understand how water flows in and around your property and street	• Observe where water flows from and to during heavy rain. This will indicate the path of potential floodwaters.	●	●	○	○
	• Consider that properties near a river, creek, gully or tidal waterway are more likely to flood.	●	●	○	○
	• Consider how fast moving flood waters may damage your home and interfere with evacuation plans.	●	○	○	○
	• Consider loss of power, road closures and interruptions to public transport.	●	●	●	●
	• Consider how close your property is to bordering other Flood Awareness Map risk areas.	●	●	●	○
Building or renovating Check Brisbane's City Plan	• You must comply with City Plan planning requirements. Visit **www.brisbane.qld.gov.au/planning-building**.	●	●	●	●
	• Download a FloodWise Property Report for information about building and development for a specific property. Visit **www.brisbane.qld.gov.au/planning-building**.	●	●	○	○
Insurance Make sure you are appropriately insured	• Talk to your insurer about flood insurance and your property.	●	●	●	●
Have an evacuation plan Create an emergency plan and emergency kit	• Prepare an emergency kit.	●	●	●	●
	• Have emergency contact phone numbers easily accessible.	●	●	●	●
	• Consider your pets. They may need temporary to long-term alternative shelter away from your home during a flood.	●	●	○	○
	• Plan multiple evacuation routes. Some roads may be cut off by floodwaters.	●	●	●	●
Personal possessions Consider how and where to move valuables during a flood event	• Store valuables and possessions (jewellery, passports, financial statements etc) safely during a flood event.	●	●	○	○
	• Consider where you can safely store your vehicle/s.	●	●	○	○
Your local area Know your local area and talk with your neighbours	• Consider how potential loss of power, road closures and interruptions to public transport could affect you.	●	●	●	●
	• Talk to your neighbours. Those living in the area for a long time may have experience of previous flood events.	●	●	○	○
	• Consider how you can help your community. The elderly, disabled or families with young children may need your help to evacuate during a flood.	●	●	●	●

N2013-03151

Flooding in Brisbane is natural and part of our environment therefore we need to be prepared for flooding and the impact it can have on our homes and families. Once you have used Council's Flood Awareness Map to identify the flood risk for your property use the tips in this table to put a plan in place. If you need an interpreter contact 131 450.

브리스번에서 홍수는 자연 현상이며 우리 환경의 일환입니다. 따라서, 우리는 홍수가 우리 집과 가족에 가져다 줄 수 있는 피해에 대비해야 합니다. 브리스번 시의회의 홍수 경계 지도 (Flood Awareness Map)를 이용하여 여러분 주택의 홍수 위험도를 파악한 후, 아래 표에 실려 있는 유용한 정보를 이용하여 계획을 세우십시오. 통역사가 필요하면 131 450번으로 연락하십시오.

Lũ lụt ở Brisbane là hiện tượng tự nhiên và là một phần của môi trường sống chúng ta, do đó chúng ta cần được chuẩn bị sẵn sàng ứng phó với lũ lụt và tác động của chúng lên mái ấm và gia đình của bạn. Nếu bạn đã dùng Bản đồ Cảnh báo Lũ lụt của Hội Đồng để xác định nguy cơ lũ lụt ở khu bất động sản của bạn, hãy dùng thông tin trong bảng này để lập kế hoạch ứng phó. Nếu bạn cần thông dịch viên, hãy liên lạc số 131 450.

洪水對於布里斯本而言是件正常的事情，是我們環境的一個部分，因此我們需要隨時準備好應對洪水以及其對我們的住宅和家人的影響。您用市政府的防洪意識地圖（Flood Awareness Map）來確定自己房產的洪水風險之後，請用本表中的建議制定一個計劃。若您需要傳譯員，請聯絡 131 450。

الفيضانات في بريزبن شيء طبيعي وجزء من بيئتنا، لذلك نحن بحاجة لأن نكون مستعدين للفيضانات وتأثيراتها المحتملة على بيوتنا وأسرنا. بعد استعمالك خريطة التوعية على الفيضانات، الخاصة بالمجلس البلدي لتحديد خطر الفيضانات على عقارك، استعمل النصائح في الجدول التالي لوضع خطتك. إذا كنت بحاجة إلى مترجم شفهي، اتصل بالرقم 450 131.

BRISBANE CITY

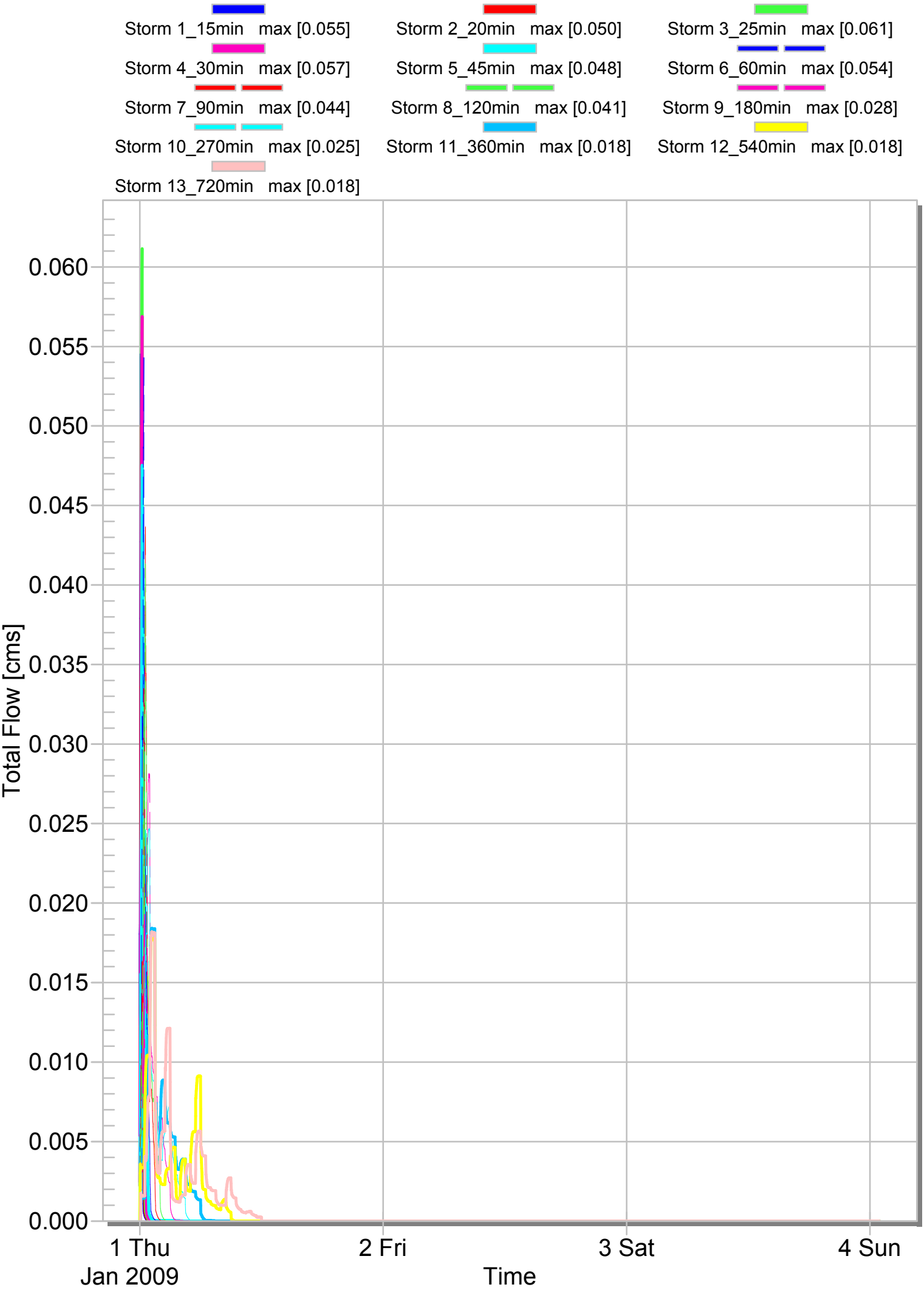
Dedicated to a better Brisbane

Appendix E

XPRafts Output – Pre Development

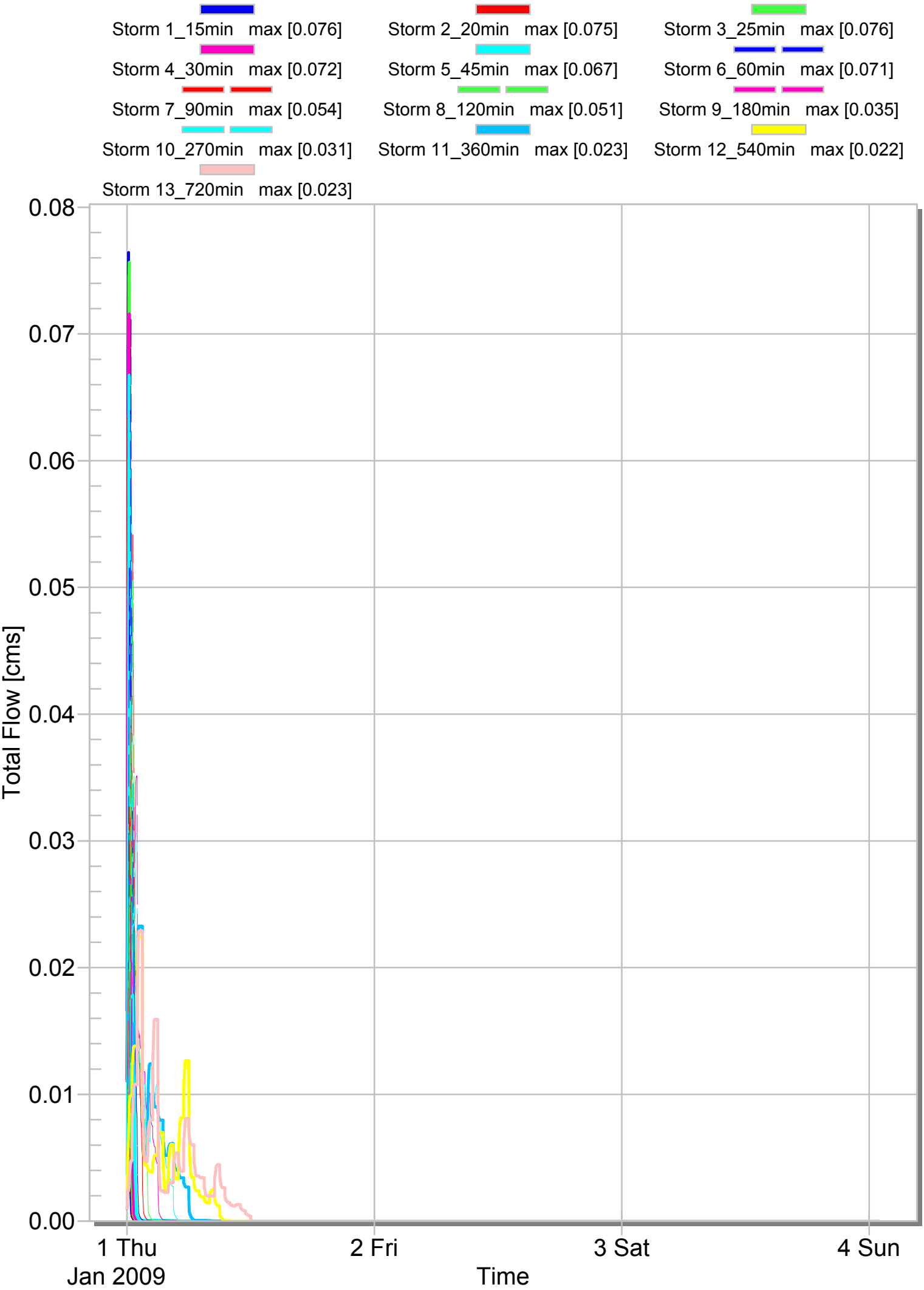
Q10 Predeveloped Discharge

Total Flow



Q50 Pre developed Discharge

Total Flow

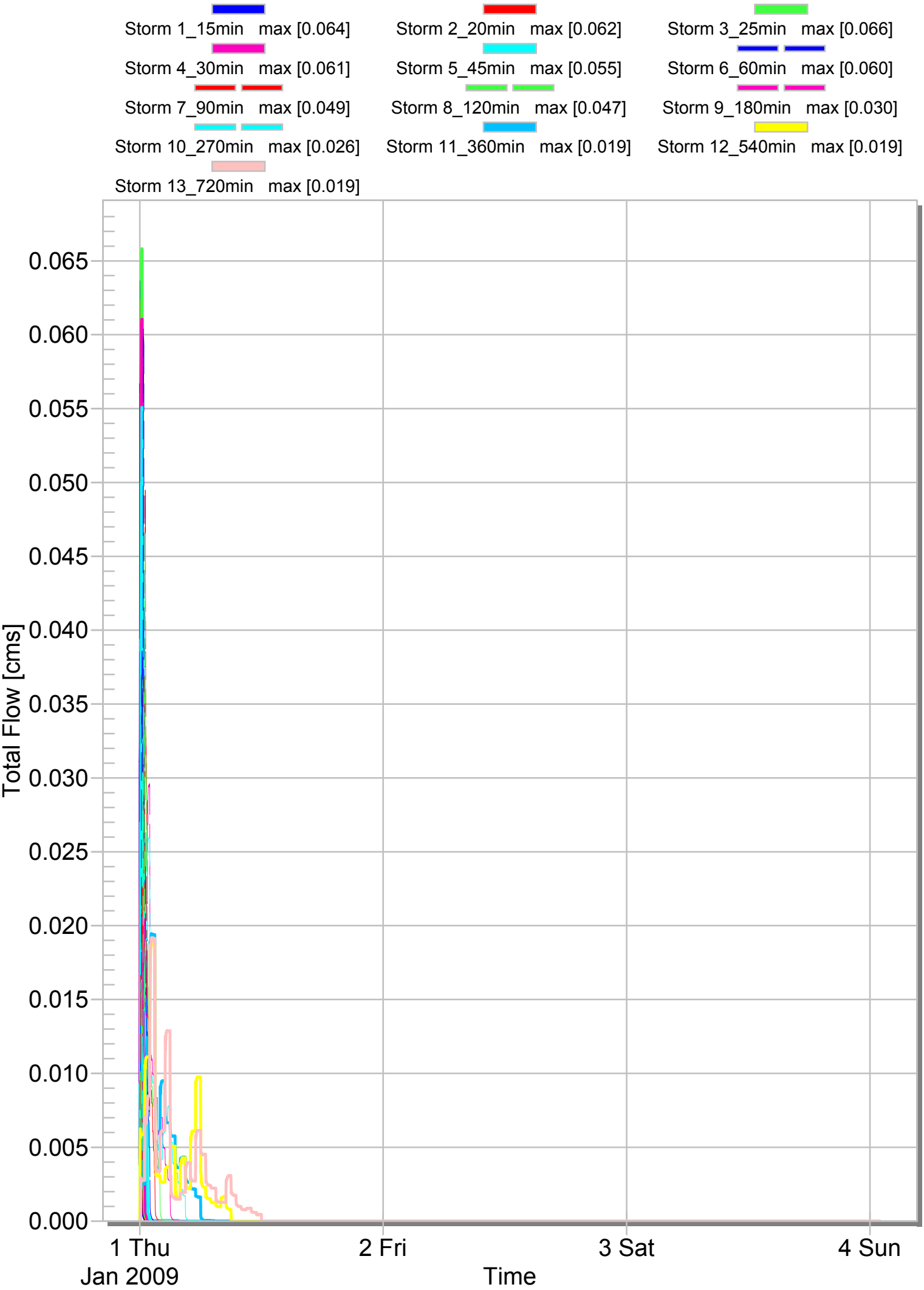


Appendix F

XPRafts Output – Post Development

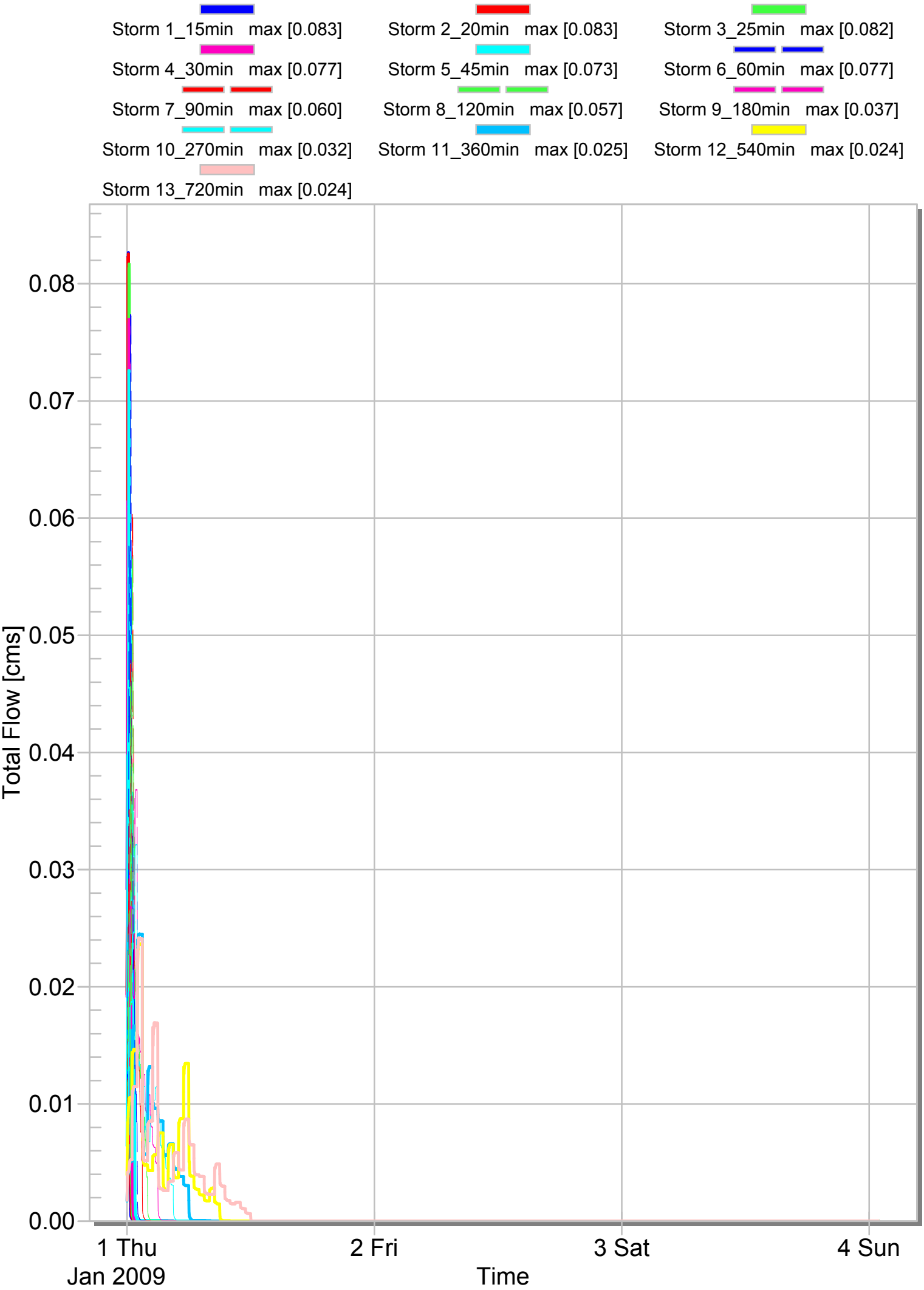
Q10 Post Developed Flow

Total Flow



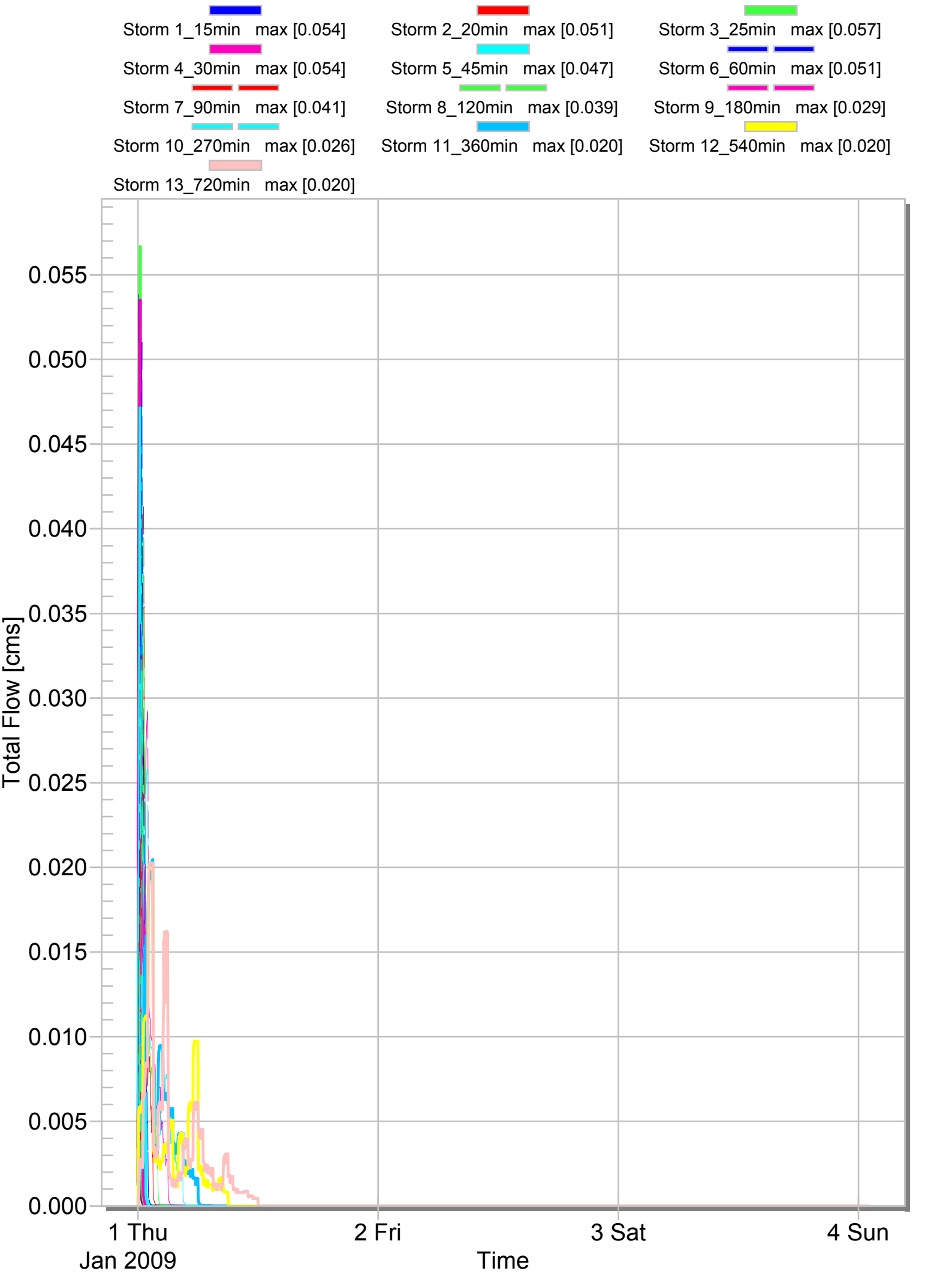
Q50 Post Discharge Unmitigated

Total Flow



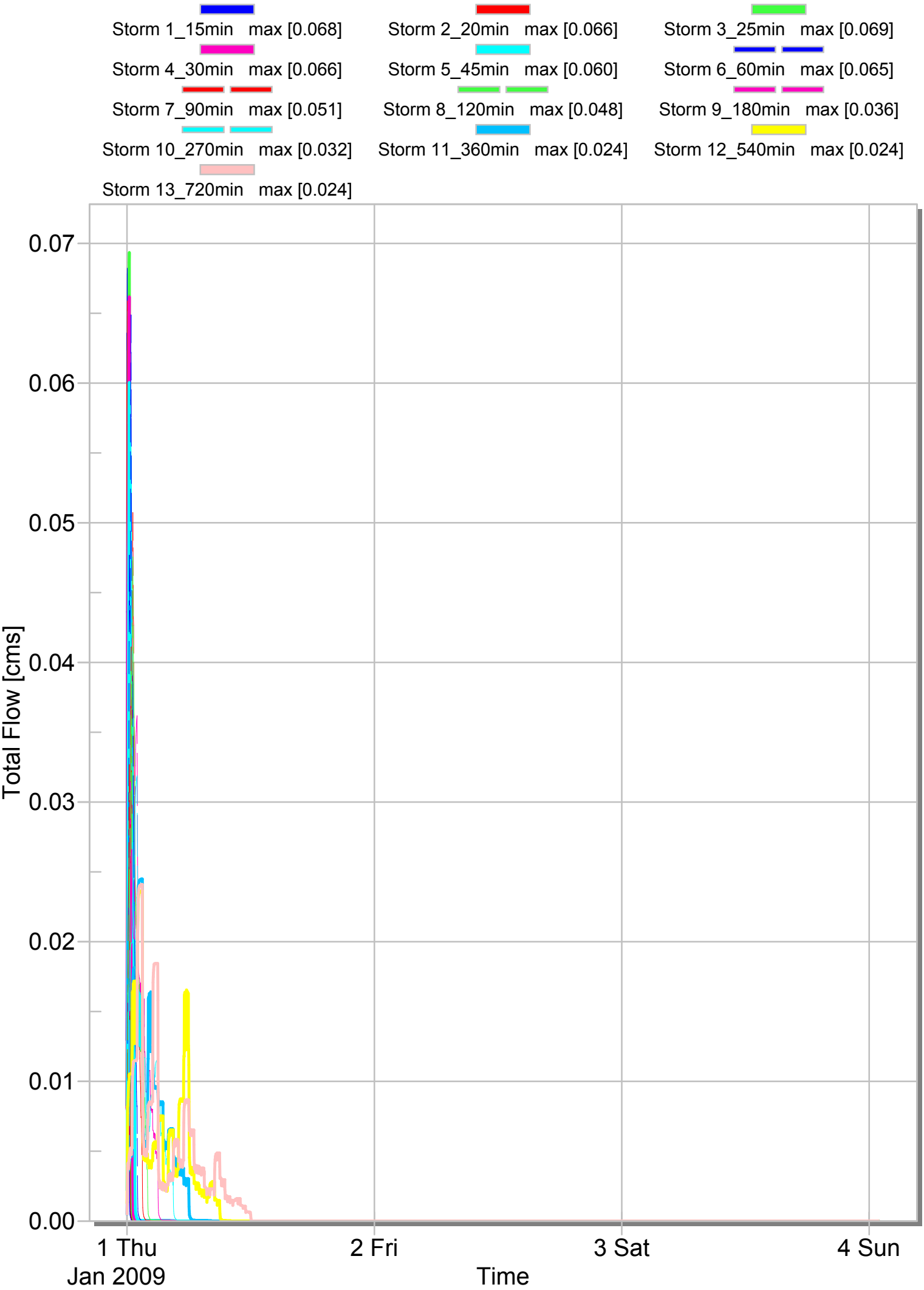
Q10 PostMitigated Discharge

Total Flow



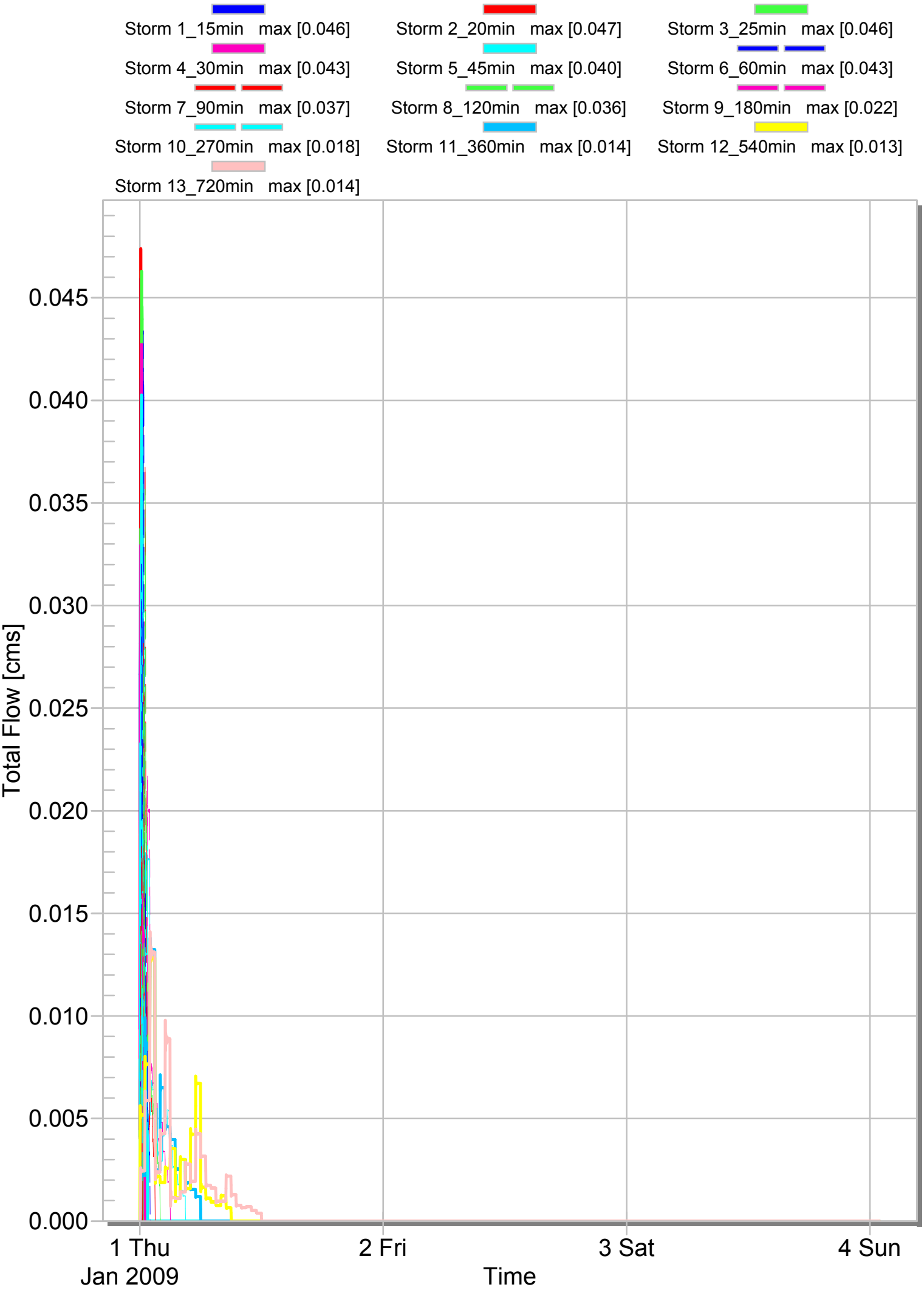
Q50 Post Mitigated Discharge

Total Flow



Q20 Roof Discharge

Total Flow



Appendix G

Rational Method Calculations

RATIONAL METHOD CALCULATIONS

Project:	5 Folkstone Street, Bowen Hills
Date:	28-Nov-14
Designed:	Wayne Clark
Comments:	Pre Developed Catchment

PARAMETERS	**VALUE**	
Catchment Name	Catch A - Pre	
Catchment Size	0.1094	ha
C10 Coefficient of Runoff	0.82	

Total Time of Concentration — BCC Standard Inlet Time for Developed Sites

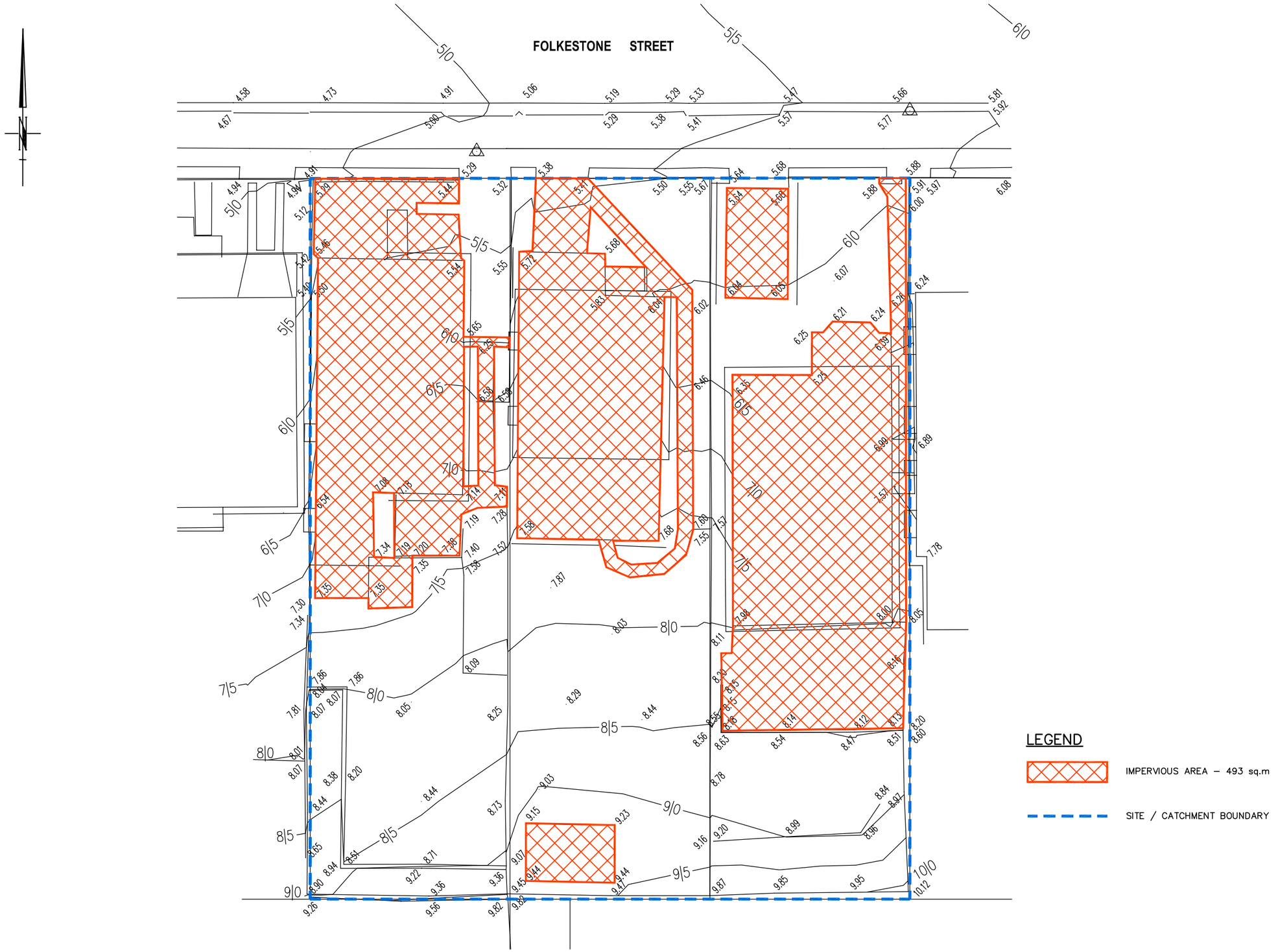
Total time of Conentration **(tc)** — **5.0 mins**

Rational Method for Peak Catchment flow — Q = 0.00278 x C x I x A

ARI	Rainfall Intensity (mm/h)	Rainfall Depth (mm)	Fy	Coefficient of Runoff	Discharge (m^3/s)
3 month					0.012
1	115.76	9.65	0.80	0.66	0.023
2	149.17	12.43	0.85	0.70	0.032
5	190.48	15.87	0.95	0.78	0.045
10	215.34	17.94	1.00	0.82	0.054
20	248.78	20.73	1.05	0.86	0.065
50	293.55	24.46	1.15	0.94	0.084
100	328.38	27.37	1.20	0.98	0.098

Appendix H

Conceptual Stormwater Management Plan



PRE–DEVELOPMENT CATCHMENT LAYOUT PLAN

Scale 1:100

Rev	Description	Drawn	Date
A	Original Issue (For App.)	WC	01/12

Associated Consultant

WSA wiltshirestevens architecture
level 5, 19 o'keefe st
woolloongabba Q 4102
P 07 3891 1811

Client

Melthorn Pty Ltd

wcdesigns
Engineering design and drafting services
0412 469 686 wayne@wcdesigns.net.au
www.wcdesigns.net.au ABN 53 965 252 887

Project

5–9 FOLKESTONE ST
BOWEN HILLS QLD

Drawing Title

DEVELOPMENT APPLICATION
PRE–DEVELOPMENT CATCHMENT
LAYOUT PLAN

Council Reference

–

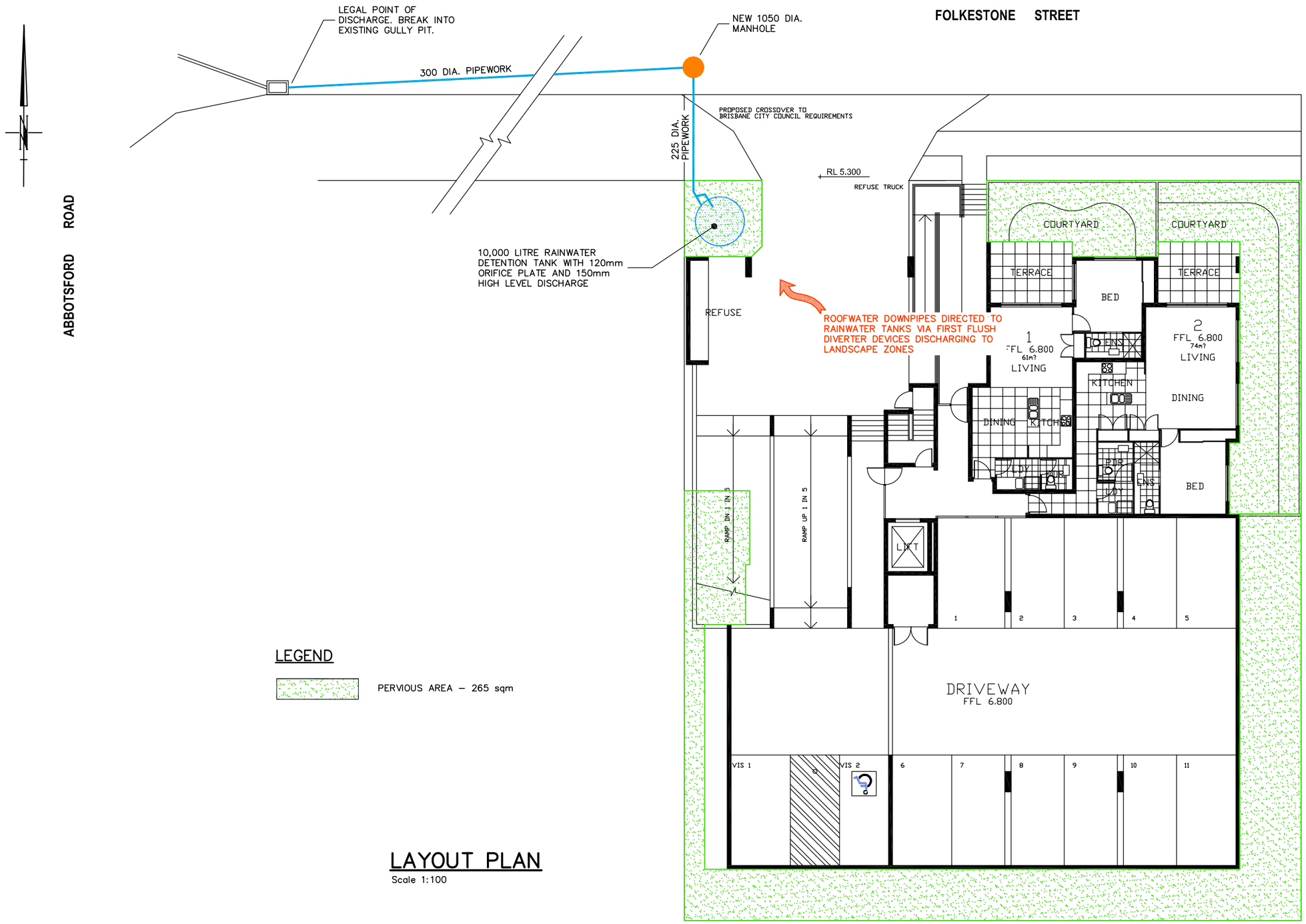
Design	Drawn	Review
Initials WC	Initials WC	Initials TG
Date 01/12/14	Date 01/12/14	Date 01/12/14

Approved
Name Thomas Gabele RPEQ No. 5442

Signed _____
Date 1 December 2014

Drawing No. WCD–044–001

Rev. A



LEGEND

PERVIOUS AREA – 265 sqm

LAYOUT PLAN

Scale 1:100

1 0 1 2 3 4 5m

SCALE 1 : 100
(BEFORE REDUCTION)

Rev	Description	Drawn	Date
A	Original Issue (For App.)	WC	01/12

Associated Consultant

WSA wiltshirestevens architecture
level 5, 19 o'keefe st
woolloongabba Q 4102
P 07 3891 1811

Client

Melthorn Pty Ltd

wcdesigns
Engineering design and drafting services
0412 469 686 wayne@wcdesigns.net.au
www.wcdesigns.net.au ABN 53 965 252 887

Project

5–9 FOLKESTONE ST
BOWEN HILLS QLD

Drawing Title

DEVELOPMENT APPLICATION
CONCEPTUAL STORMWATER
MANAGEMENT PLAN

Council Reference

–

Design	Drawn	Review
Initials WC	Initials WC	Initials TG
Date 01/12/14	Date 01/12/14	Date 01/12/14

Approved
Name T. Gabele RPEQ No. 5442

Signed _____
Date 1 December 2014

Drawing No.	Rev.
WCD–044–002	A

Appendix J

Performance Criteria Code Responses

1.0 Stormwater Management Code

Performance Criteria and Acceptable Solutions

Performance Criteria	Acceptable Solutions	Solution	Comments
Section A—If for a material change of use, reconfiguring a lot, operational work or building work *Note—Compliance with the performance outcomes and acceptable outcomes in this section should be demonstrated by the submission of a site-based stormwater management plan for high risk development only.*			
PO1 Development provides a stormwater management system which achieves the integrated management of stormwater to: (a) minimise flooding; (b) protect environmental values of receiving waters; (c) maximise the use of water sensitive urban design; (d) minimise safety risk to all persons; (e) maximise the use of natural waterway corridors and natural channel design principles. *Editor's note—The stormwater management*	**AO1** Development provides a stormwater management system designed in compliance with the Infrastructure design planning scheme policy.	A	

system to be developed to address PO1 is not intended to require management of stormwater quality.			
PO2 Development ensures that the stormwater management system and site work does not adversely impact flooding or drainage characteristics of premises which are up slope, down slope or adjacent to the site.	**AO2.1** Development does not result in an increase in flood level or flood hazard on up slope, down slope or adjacent premises.	A	
	AO2.2 Development provides a stormwater management system which is designed in compliance with the standards in the Infrastructure design planning scheme policy.	A	
PO3 Development ensures that the stormwater management system does not direct stormwater run-off through existing or proposed lots and property where it is likely to adversely affect the	**AO3.1** Development ensures that the location of the stormwater drainage system is contained within a road reserve, drainage reserve, public pathway, park or waterway corridor.	A	

	AO3.2 Development provides a stormwater management system which is designed in compliance with the standards in the Infrastructure design planning scheme policy.	A	
	AO3.3 Development obtains a lawful point of discharge in compliance with the standards in the Infrastructure design planning scheme policy.	A	
	AO3.4 Where on private land, all underground stormwater infrastructure is secured by a drainage easement.	A	
PO4 Development provides a stormwater management system which has sufficient capacity to safely convey run-off taking into account increased run-off from impervious surfaces and flooding in local catchments.	**AO4.1** Development provides a stormwater conveyance system which is designed to safely convey flows in compliance with the standards in the Infrastructure design planning scheme policy.	A	
	AO4.2 Development provides sufficient area to convey	A	

	run-off which will comply with the standards in the Infrastructure design planning scheme policy.		
PO5 Development designs stormwater channels, creek modification works, bridges, culverts and major drains to protect and enhance the value of the waterway corridor or drainage path for fauna movement.	**AO5** Development ensures the design of stormwater channels, creek modifications or other infrastructure, permits terrestrial and aquatic fauna movement.	N/A	
PO6 Development ensures that location and design of stormwater detention and water quality treatment: (a) minimises risk to people and property; (b) provides for safe access and maintenance; (c) minimises ecological impacts to creeks and waterways.	**AO6.1** Development locates stormwater (a) detention and water quality treatment: (b) outside of a waterway corridor; (c) offline to any catchment not contained within the development.	A	
	AO6.2 Development providing for stormwater detention and water quality treatment devices are designed in compliance with the standards in the Infrastructure design planning scheme	A	

	policy.		
PO7 Development is designed, including any car parking areas and channel works to: (a) reduce property damage; (b) provide safe access to the site during the defined flood event.	**AO7.1** Development (including any ancillary structures and car parking areas) is located above minimum flood immunity levels in Table 9.4.9.3.B, Table 9.4.9.3.C, Table 9.4.9.3.D, Table 9.4.9.3.E and Table 9.4.9.3.F. *Note—Compliance with this acceptable outcome can be demonstrated by the submission of a hydraulic and hydrology report identifying flood levels and development design levels (as part of a site-based stormwater management plan).*	A	
	AO7.2 Development including the road network provides a stormwater management system that provides safe pedestrian and vehicle access in accordance with the standards in the Infrastructure design planning scheme policy.	A	

PO8 Development designs stormwater channels, creek modification works and the drainage network to protect and enhance the environmental values of the waterway corridor or drainage path.	**AO8.1** Development ensures natural waterway corridors and drainage paths are retained.	A	
	AO8.2 Development provides the required hydraulic conveyance of the drainage channel and floodway, while maximising its potential to maximise environmental benefits and minimise scour. *Editor's note—Guidance on natural channel design principles can be found in the Council's publication Natural channel design guidelines.*	N/A	
	AO8.3 Development provides stormwater outlets into waterways, creeks, wetlands and overland flow paths with energy dissipation to minimise scour in compliance with the standards in the Infrastructure design planning scheme policy.	N/A	

	AO8.4 Development ensures that the design of modifications to the existing design of new stormwater channels, creeks and major drains is in compliance with the standards in the Infrastructure design planning scheme policy.	N/A	
PO9 Development is designed to manage run-off and peak flows by minimising large areas of impervious material and maximising opportunities for capture and re-use.	**AO9** No acceptable outcome is prescribed.	A	
PO10 Development ensures that there is sufficient site area to accommodate an effective stormwater management system. *Note—Compliance with the performance outcome should be demonstrated by the submission of a site-based stormwater management plan for high-risk development only.*	**AO10** No acceptable outcome is prescribed.	A	

PO11 Development provides for the orderly development of stormwater infrastructure within a catchment, having regard to the: (a) existing capacity of stormwater infrastructure within and external to the site, and any planned stormwater infrastructure upgrades; (b) safe management of stormwater discharge from existing and future up-slope development; (c) implication for adjacent and down-slope development.	**AO11.1** Development with up-slope external catchment areas provides a drainage connection sized for ultimate catchment conditions that is directed to a lawful point of discharge.	N/A	
	AO11.2 Development ensures that existing stormwater infrastructure that is undersized is upgraded in compliance with the Priority infrastructure plan and the standards in the Infrastructure design planning scheme policy.	A	
PO12 Development provides stormwater infrastructure which: (a) remains fit for purpose for the life of the development and maintains full functionality in the design flood event; (b) can be safely accessed and maintained cost effectively;	**AO12.1** The stormwater management system is designed in compliance with the Infrastructure design planning scheme policy.	A	
	AO12.2 Development provides a clear area with a minimum of 2m radius from the centre of an existing manhole cover and with a minimum	A	

(c) ensures no structural damage to existing stormwater infrastructure.	height clearance of 2.5m.		
PO13 Development ensures that all reasonable and practicable measures are taken to manage the impacts of erosion, turbidity and sedimentation, both within and external to the development site from construction activities, including vegetation clearing, earthworks, civil construction, installation of services, rehabilitation, revegetation and landscaping to protect: (a) the environmental values and water quality objectives of waters; (b) waterway hydrology; (c) the maintenance and serviceability of stormwater infrastructure. *Note—The Infrastructure design planning scheme policy outlines the appropriate measures to be taken into account to achieve the performance outcome.*	**AO13** No acceptable outcome is prescribed.	A	

PO14 Development ensures that: (a) unnecessary disturbance to soil, waterways or drainage channels is avoided; (b) all soil surfaces remain effectively stabilised against erosion in the short and long term.	**AO14** No acceptable outcome is prescribed.	A	
PO15 Development does not increase: (a) the concentration of total suspended solids or other contaminants in stormwater flows during site construction; (b) run-off which causes erosion either on site or off site.	**AO15** No acceptable outcome is prescribed.	A	
Section B—Additional criteria which apply to high-risk development, being one or more of the following: (a) a material change of use for an urban purpose which involves greater than 2,500m2 of land that: • will result in an impervious area greater than 25% of the net developable area; or • will result in 6 or more dwellings. (b) reconfiguring a lot for an urban purpose that involves greater than 2,500m2 of land and will result in 6 or more lots;			

(c) operational work for an urban purpose which involves disturbing greater than 2,500m2 of land.			
PO16 Development ensures that the entry and transport of contaminants into stormwater is avoided or minimised to protect receiving water environmental values. *Note—Prescribed water contaminants are defined in the Environmental Protection Act 1994.* *Note—Compliance with the performance outcome should be demonstrated by the submission of a site-based stormwater management plan for high-risk development only.*	**AO16** Development provides a stormwater management system which is designed in compliance with the standards in the Infrastructure design planning scheme policy.	N/A	
PO17 Development ensures that: (a) the discharge of wastewater to a	**AO17** No acceptable outcome is prescribed.	N/A	

waterway or external to the site is avoided; or (b) if the discharge cannot practicably be avoided, the development minimises wastewater discharge through re-use, recycling, recovery and treatment. *Note—The preparation of a wastewater management plan can assist in demonstrating achievement of this performance outcome.* *Editor's note—This code does not deal with sewerage which is the subject of the Wastewater code.*			

Solution Legend

A = Acceptable Solution

A/S = Alternate solution proposed

N/A = Not applicable to this application