Memorandum

Date:	27/01/16	File:	61264
		Pages:	14 (including this page)
To:	Catherine Reaburn		
From:	Pranil Wadan;		
Re:	187 Flat Bush School Road Amended Stormwater Management Plan (Preliminary)		

Summary

This memo describes a preliminary stormwater management plan for the proposed Ministry of Education (MoE) school development at 187 Flat Bush School Road, Auckland. At the time of writing, the school layout is yet to be confirmed. The stormwater runoff calculations are therefore based on an existing primary school layout until the final design has been confirmed.

1. Stormwater Management Design Criteria

The stormwater management options presented in this memorandum have been presented according to the Stormwater Unit's current NDC requirements around water quality and flood mitigation in the Flat Bush area. This approach is summarised as follows:

- The use of ponds for flood mitigation is no longer required,
- Stormwater treatment to be provided depending on whether proposed land use is considered a High Contaminant Generating Activity (HCGA) using Water Sensitive Design (WSD), and
- Stream health to be protected in terms of stream erosion.

The stormwater management plan includes the use of inert roofing material, with retention to be provided at source (see Toolbox Options included within the memorandum) and dry basin providing attenuation of flow for the 95th percentile event only.

It should be noted that the runoff volumes calculated in this preliminary options memorandum are likely to change once the site layout has been finalised.

2. Stormwater Management Plan & Catchment Description

2.1 Existing Catchment

The existing site falls within the 'Flat Bush Residential 1' zone under the East Tamaki Catchment Management Plan. Access to the site is via a gravel drive off Flat Bush School Road. The land use is currently pasture with no impervious areas. The soil on site comprises pumiceous mud/sand and gravel. The topography falls from the south to the north towards a fully protected stream that passes close to the eastern property boundary. There is also a lowland ephemeral stream which passes through the site.

2.2 Proposed Changes to Catchment

The proposal is to develop a portion of the site into an early childhood centre and primary school with associated playing fields, carparks and school facilities. As a result the impervious cover on the developed portion of the site will significantly increase. This will change the catchment characteristic from a rural holding to an educational facility.

As a school layout is yet to be determined the following areas (based on a typical school layout) have been assumed to form the stormwater management plan

- Roof area of approximately 5000m^2
- Hardstand area of approximately 8300m^2
- Pervious area of approximately 19000m^2

2.3 Stormwater Management Plan

At present, there is no public stormwater network servicing the site. Following discussion with Auckland Council representatives, alternate measures for the management of stormwater runoff from the developed site have been considered. The stormwater management strategy on site involves discharging to the fully protected stream that passes near the eastern site boundary.

Low Impact Design (LID) elements have been considered in order to treat and attenuate runoff prior to discharging to the fully developed stream. The stormwater management options presented below are in accordance with the revised NDC requirements and discussions with representatives from the Auckland Council Stormwater Unit. These are as follow:

- First 5.5mm (after accounting for exfiltration and evapotranspiration) of runoff from impervious surfaces to satisfy the retention component. This includes the following:
    - First 5.5mm of roof runoff will be captured for reuse (roofing material will not be made from contaminant material), and
    - First 5.5 mm of runoff from roads and hardstand areas to be retained in retention raingardens. These devices will have shallow rooting plants so as to prevent the device from being too deep.

- Stormwater runoff for the hardstand areas for the whole site will be attenuated in a centralized dry basin for the 95th percentile event rainfall depth (30.5mm after accounting for losses due to exfiltration and evapotranspiration). All flows in excess of the 95th percentile detention volume will be released into the neighbouring stream.

It should be noted that the raintanks for the roofed areas can be sized for detention purposes as well as retention (via re use), however for the purpose of this memo, only the retention component has been accounted for on the assumption that detention will be undertaken in the dry basin. The full detention/retention component will be further explored during the detailed design stage.

Runoff from hardstand surfaces will be treated via the strategic placement of raingardens in car park areas. Runoff from remaining hardstand areas such as footpaths etc. will discharge to treatment swales designed for treatment and retention will be provided.

The stormwater management elements have been summarized as a schematic in shown in Figure 1.

The stormwater management plan is summarised in Figure 1.

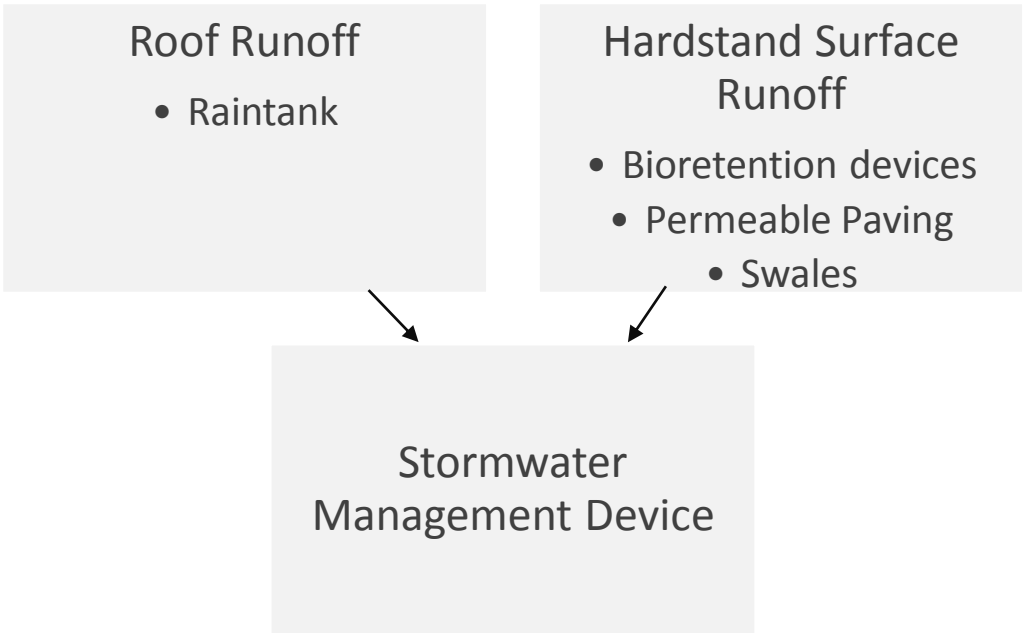


Figure 1: Stormwater Management Plan

3. Stormwater Modelling

Preliminary desktop calculations have been used to determine runoff for the pre and post development scenarios and for the preliminary sizing for the proposed stormwater management device.

Runoff volumes were determined in HEC-HMS, with the model set up as follows in Figure 2.

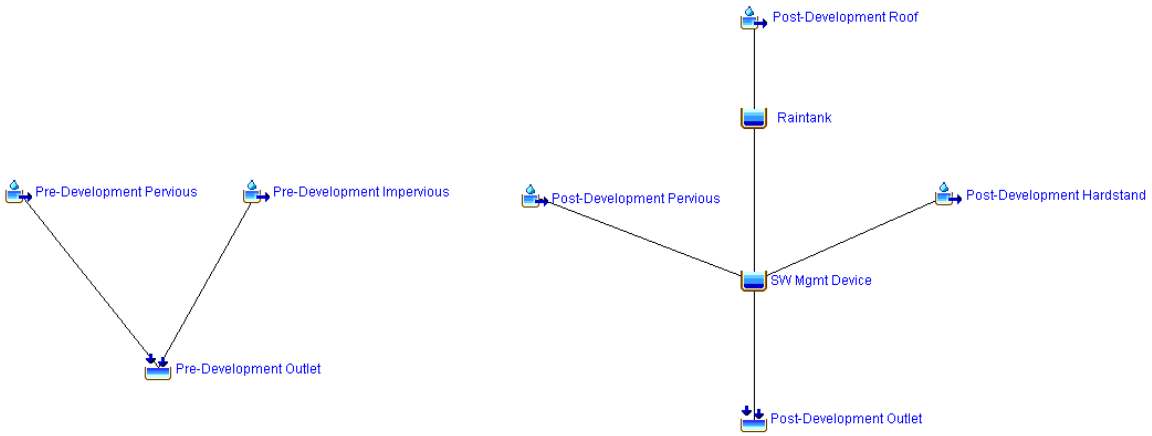


Figure 2: Stormwater Model Setup

The model includes a rain tank receiving roof runoff with an estimated volume of 30m^3. The rain tank will be placed in series with the stormwater management device (dry detention basin) and will serve the dual purpose of flow attenuation and water reuse.

In order to provide a conservative estimate of flows reaching the stormwater management device, the reuse and attenuation functions have not been included in the modelling. Instead, all flows in excess of 30m^3 drains to the stormwater management device.

The stormwater management device receiving runoff from the hardstand areas and rain tank overflows has been modelled as a reservoir in order to estimate the volume to be attenuated in the 95th percentile event.

The attenuation measures are in accordance with Auckland Regional Council's Technical Publications TP10 (2003), TP108 (1999) and were modelled accordingly in HEC HMS.

4.1 Parameters used in Stormwater Modelling

Rainfall: The 24 hour rainfall depth used to determine flows in the 95th Percentile storm event is 30.5mm, inclusive of the retention depth of 5.5mm. The rainfall profile follows the unit hydrograph as per TP108.

Catchment Areas: As discussed in Section 2.2, the areas used in the modelling are based on a typical school layout.

Catchment Parameters: The proposed school has been based on assumed areas for the roof, hardstand and landscaped areas. This allowed for a roof area of 5083m^2 and hardstand surface area of 8350m^2, taking the impervious cover of the site to 41%.

The underlying soil type is unknown and for the purposes of this report has been assumed to be soil type C, as classified in TP108. This will be confirmed during detailed design of the school.

Table 1: Existing and Proposed Layout Areas

	Roof Area (ha)	Hardstand Area (ha)	Pervious Area (ha)	Total Area (ha)
Existing	-	-	3.25	3.25
Proposed	0.5083	0.8350	1.9077	3.25

SCS Parameters: The runoff from this event was calculated using the SCS Hydrology Method as set out in TP108. A SCS Lag time of 6.67 minutes (minimum) was used. A curve number of 74 was used to mimic the existing ground conditions on site with an initial abstraction of 5mm. This curve number is based on Table 3.3 from TP108. This is to be refined upon a geotechnical investigation. A curve number of 98 was used for impervious cover.

Table 2: Catchment Characteristics

	Pre-Developed	Post-Developed
Total Area (ha)	3.25	3.25
Pervious Area (ha)	3.25	1.984
Impervious Area (ha)	0	1.266
Channelization Factor (C)	0.8	0.6
Catchment Length L (km)	0.16	0.16
Catchment Slope Sc (%)	2.3%	2.3%*

*Assumed. Slope to be confirmed at detailed design stage

Table 3: CN and Ia values used

Cover Description	**(CN)**
Impervious Cover	98
Pervious Group	74
Initial Abstraction	**Ia(mm)**
Impervious	0
Pervious	5

Table 4: Tc calculations

	Pre - Development	Post - Development
Runoff Factor = CN/(200-CN)	0.60	0.71
tc =0.14 C x $L^{0.66}$ x $[CN/(200-CN)]^{-0.55}$x$Sc^{-0.30}$ (hrs)	*0.166	*0.166
SCS L**ag for HEC-HMS "tp" =2/3 tc (mins**)	*6.66	*6.66

** Adopted time of concentration and SCS Lag based on minimum Tc of 10mins*

4.3 Summary of Modelling Results

The results from the HEC HMS model showed that the peak outflow from the developed site during the 95th percentile event of 0.0049m³/s is less than the maximum release flow of 0.009m³/s when using the proposed stormwater management plan with parameters and assumptions as detailed above. The results from the model are summarised in Table 6.

Table 5: Modelling Result Summary

ARI Storm Event	Total Pre Development Peak Flow Discharge (m3/s)	Total Post Development Peak Flow Discharge (m3/s)
95th Percentile Event	0.0161	0.0049

The post development flows in the model are routed via a stormwater management device which has been represented with a reservoir within HEC-HMS. Flows out of the device has been restricted using a low flow orifice of diameter 0.15m, at the invert of the device. This results in the peak runoff flow being released over 24 hours to ensure net flows leaving the site do not exceed the maximum release flow rate. The orifice structure is too optimised during detailed design stage and once a school layout has been confirmed, HEC Modelling shows that the dry basin does not completely drains over 24 hours and that further refinement of the basin and outlet structure is required.

The flow through the low flow orifice was modelled using the orifice equation:

$$Q = 0.62A\ (2gh)\ 0.5$$

The HEC model results confirms that a storage capacity of 300m³ is required for the 95th percentile storm event.

The stormwater management device will ideally be a dry basin, which will be located close to the fully protected stream within the school playing field. It should be noted that the raintanks for the roofed areas can be sized to incorporate detention, however for the purpose of this memo it assumed that all detention will be undertaken in the dry basin. The full detention/retention component will be further explored during the detailed design stage.

For detailed HEC HMS results please refer to Appendix A.

4. Recommendations

A preliminary desktop modelling exercise has been conducted to manage stormwater for the proposed school development at 187 Flat Bush School Road. This was carried out based on assumptions made regarding the layout of the site. The following stormwater management elements are proposed to be included for the school:

1. Roof runoff will be captured via rain tanks for the purpose of re-using and attenuating peak flows
2. Runoff from hardstand surfaces such as carparks will discharge to bioretention devices such as rain gardens or treatment swales.
3. Permeable pavement to be used where possible, permeable paving seen as hydraulically neutral and therefore will not require additional mitigation
4. All overflows and treatment swale discharge will be directed towards a dry basin which will provide detention for the 95th percentile event.
5. Incorporate the use of other methods for stormwater reuse to achieve water sensitive design

It is recommended to finalise the site layout and areas before sizing for stormwater management devices.

5. Conclusions

It is concluded that stormwater as a result of development of a school on this site can be managed in accordance with Auckland Council's current requirements for the management of stormwater within the Flat Bush catchment.

It is proposed that a complete and final stormwater management plan will be provided at the Establishment outline Plan of Works stage in which the following conditions will be satisfied:

- Incorporate the use of stormwater reuse to achieve water sensitive design
- The location and sizing of the onsite stormwater detention/retention and/or connection to Auckland Council's public stormwater network;
- Management of the overland flow path;
- Management of any flooding hazards at the time of development.

6. References

Design Guideline Manual for Stormwater Treatment Devices – Technical Publication 10 (2003). Auckland Regional Council.

Guidelines for Stormwater Runoff Modelling in the Auckland Region – Technical Publication 108 (1999). Auckland Regional Council.

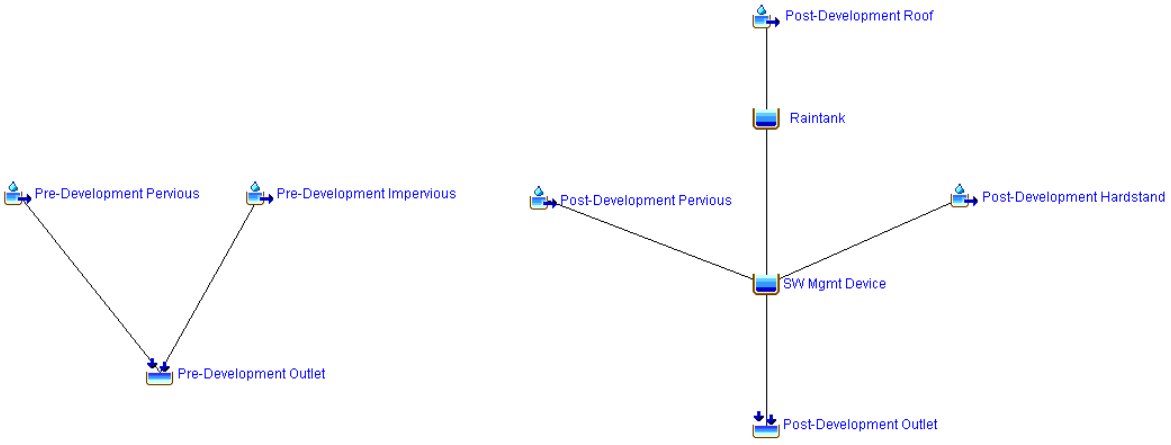
Auckland Unitary Plan stormwater management provisions: technical basis of contaminant and volume management requirements – Technical Report 2013/035 (2013). Auckland Council.

Flatbush Catchment Management Implementation Plan (Version 6) – Technical Report (2004). Beca.

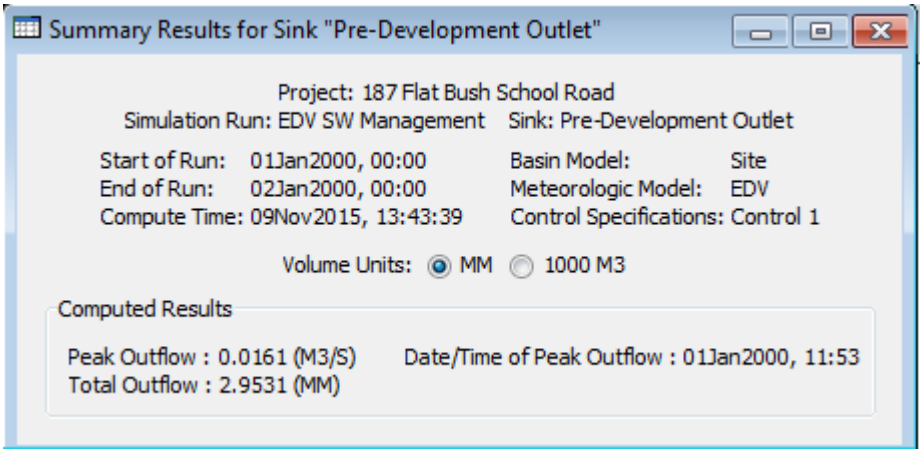
East Tamaki Comprehensive Catchment Management Plan – Technical Report (2001). Beca Carter Hollings and Ferner.

Memorandum

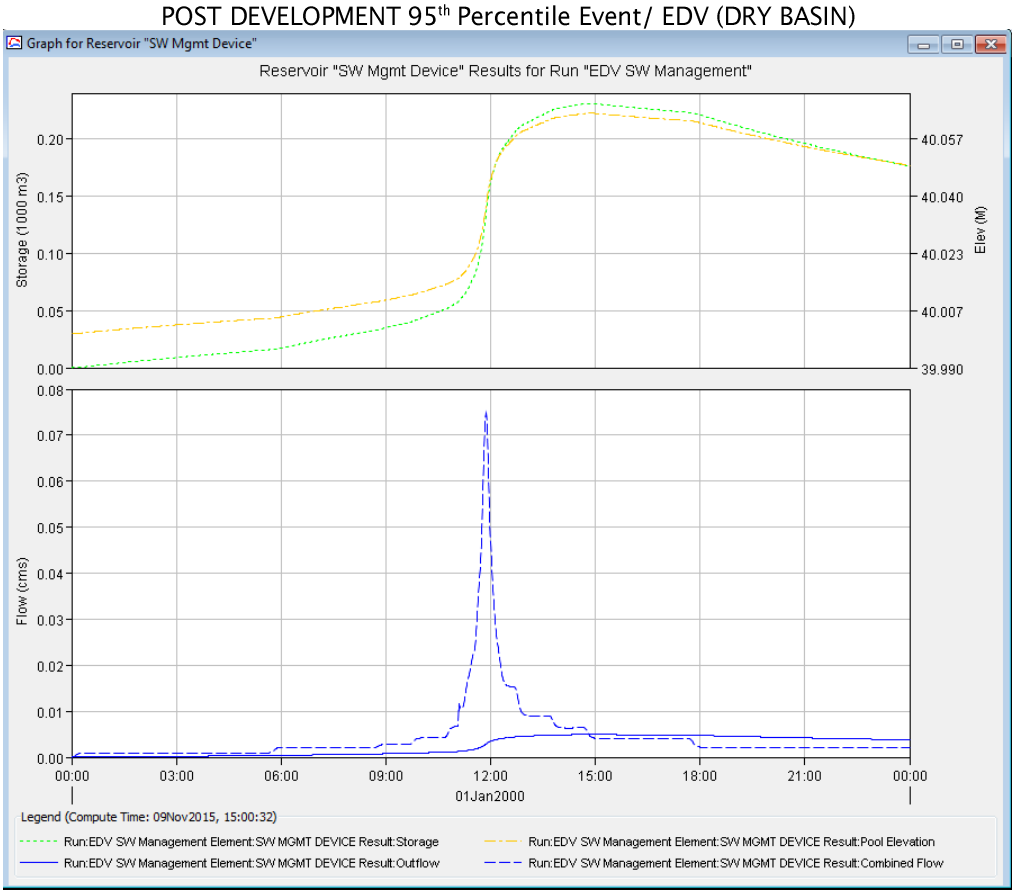
APPENDIX A
HEC-HMS MODEL RESULTS

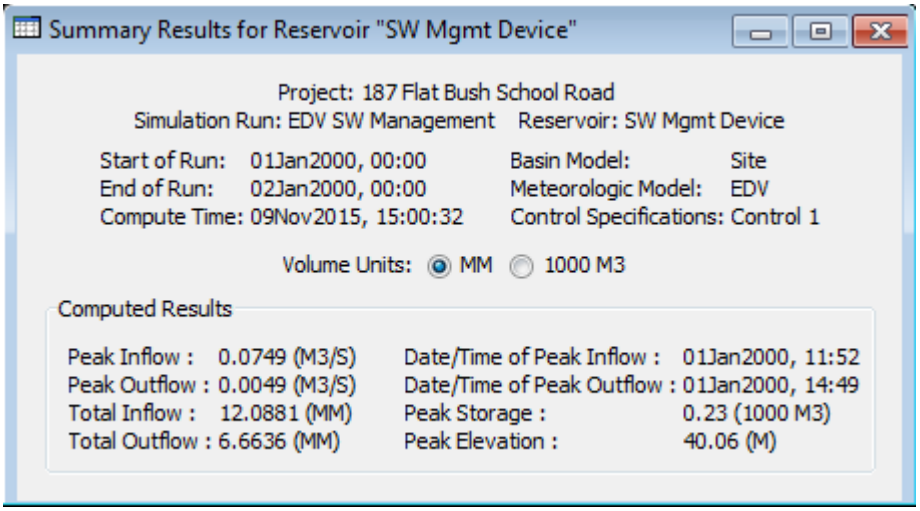


PRE DEVELOPMENT 95th Percentile / EDV



POST DEVELOPMENT 95th Percentile Event/ EDV (DRY BASIN)





Memorandum

GLOBAL SUMMARY

Global Summary Results for Run "EDV SW Management"

Project: 187 Flat Bush School Road Simulation Run: EDV SW Management

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 09Nov2015, 15:05:49

Basin Model: Site
Meteorologic Model: EDV
Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Hydrologic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pre-Development Pervious	0.030880	0.0078	01Jan2000, 11:53	1.5296
Pre-Development Impervious	0.001600	0.0084	01Jan2000, 11:52	30.4275
Pre-Development Outlet	0.032480	0.0161	01Jan2000, 11:53	2.9531
Post-Development Pervious	0.019077	0.0048	01Jan2000, 11:53	1.5296
Post-Development Hardstand	0.008350	0.0436	01Jan2000, 11:52	30.4275
Post-Development Roof	0.005083	0.0266	01Jan2000, 11:52	30.4275
Raintank	0.005083	0.0265	01Jan2000, 11:52	21.5884
SW Mgmt Device	0.032510	0.0049	01Jan2000, 14:49	6.6636
Post-Development Outlet	0.032510	0.0049	01Jan2000, 14:49	6.6636