Stormwater Management Plan, September 2014
(updated May 2015 to address 3rd Tributary)
(Graeme McGill Consulting Engineers)

Report

PROPOSED SUBDIVISION OF CONSOLIDATED ERF A/8343 AND R/2224, HOUT BAY:

STORMWATER MANAGEMENT PLAN

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PROPOSED SUBDIVISION OF CONSOLIDATED ERF A/8343 AND R/2224, HOUT BAY: STORMWATER MANAGEMENT PLAN

1. PROPOSED DEVELOPMENT

The site is located above Oakhurst farm stall in Hout Bay, and to the west of Blue Valley Road (Figure 1).

The proposed development of consolidated erven A/8343 and R/2224, Hout Bay, is shown on the enclosed subdivision sketch plan E R/2224 HBAY SUBDIV/06. This is a residential development on a partly mountainous terrain. The consolidated area is 78,2 ha of which, 10,1% is for residential, 2,8% is for roads, 10,6% is for internal rural and open public space, and 74,1% is for external rural. The intended rural portion is located in the southern mountainous section

The subject of this report is the management of the quality, volume and rate of stormwater runoff from the site, with a view to meeting the objectives as set out in the City of Cape Town policy document no. C58/05/09 “Management of Urban Stormwater Impacts Policy”.

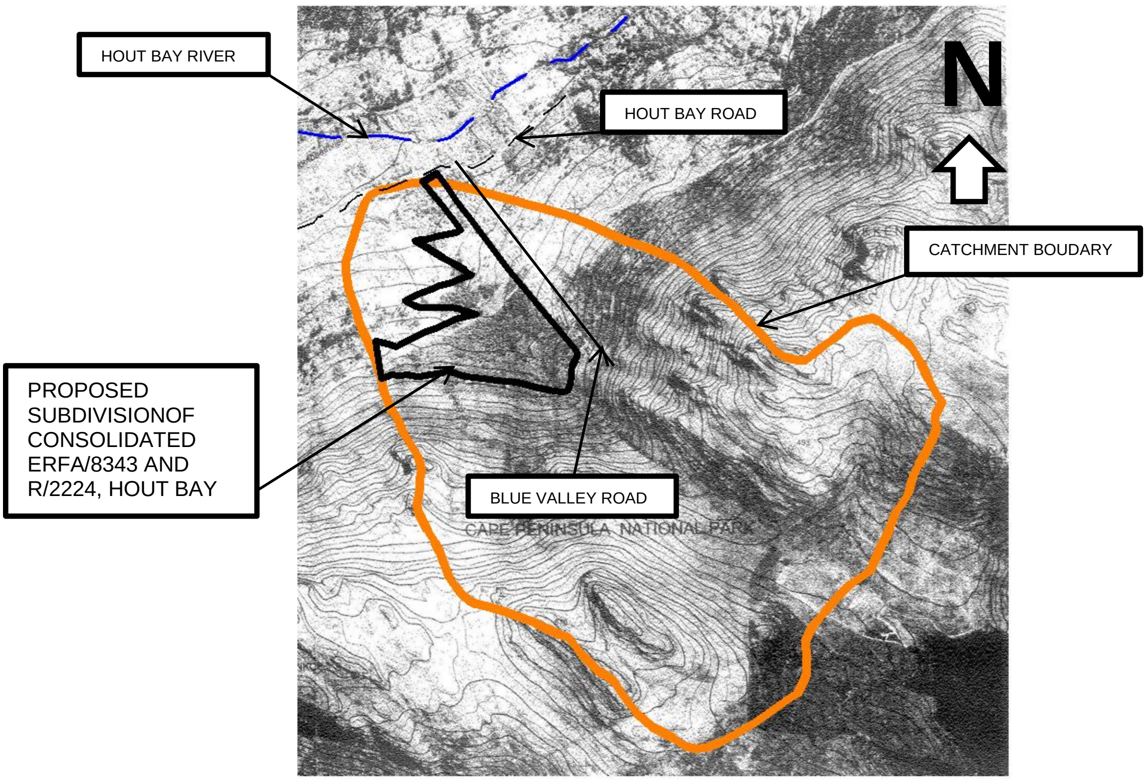


FIGURE 1: LOCALITY PLAN

2. CITY OF CAPE TOWN POLICY REQUIREMENTS

The goal of the City of Cape Town's Management of Urban Stormwater Impacts Policy is to implement Sustainable Urban Drainage Systems (SUDS) which attempt to maintain or mimic the natural flow systems as well as prevent the wash-off of urban pollutants to receiving waters. These objectives for various development scenarios are set out in the table in Annexure A.

For the proposed development the following objectives are to be achieved:

1	**OBJECTIVE: IMPROVE QUALITY OF RUNOFF** Reduction of post-development annual stormwater pollutant load discharged from the development site: • Suspended solids SS – 80% reduction • Total phosphorus TP – 45% reduction
2	**OBJECTIVE: CONTROL QUANTITY AND RATE OF RUNOFF**
2.1	Protect the stability of downstream channels Provide extended detention of the 1:1 year 24 hour duration storm.
2.2	Protect downstream properties from fairly frequent nuisance floods Up to the 1:10 year peak flow to be reduced to pre-development level.
2.3	Protect floodplain developments and floodplains from adverse impacts of extreme floods Up to 1:50 year peak flow to be reduced to existing development level. Evaluate effects of 1:100 year storm event on the stormwater management system, adjacent property and downstream facilities and property.

3. SITE DESCRIPTION

The portion of the consolidated erven, which is to be developed is located on the relatively steep terrain with slopes ranging from 5% to 15%. The vegetation cover is good at present, however areas which become denuded will be highly vulnerable to erosion.

A main water course and two tributaries pass through the development. Previous studies have been carried out to determine the 1:50 and 1:100 floodlines on the main stream. In addition a wetland has been identified adjacent to this intercourse, in the area immediately to the north of the road reserve for the planned Main Road no. 12.

The proposed development has been planned taking into account of these features by allowing for buffers along the river (30m from top of bank) and around the wetland (32m). Also the larger erven are located on the steeper portion of the site. The development on these erven is likely to be less intensive and therefore have a lesser impact on the areas more vulnerable to erosion.

The erven along the southern edge of the proposed development will receive overland flow from the mountain slopes which must be safely conveyed through the development to the main watercourse.

Some runoff will also be received from the Blue Valley Road side of the development, which must be accommodated.

4. STORMWATER RUNOFF

4.1. METHODOLOGY

In order to prepare a management plan for the stormwater which is generated on the site, and that which flows through the site it is necessary to simulate the runoff for a range of recurrence intervals.

This has been done using the HEC-HMS model (v3.5.5) with the SCS method of infiltration and runoff being employed. The storm inputs are described below.

4.2. STORM RAINFALL

The City of Cape Town commissioned the University of Kwazulu Natal to investigate possible impact of climate change on storm intensities. The outcome of this study has been accepted by the City of Cape Town, and has been issued in the form of point rainfalls for a range of recurrence intervals and storm duration, on a one minute by one minute grid. These values make allowances of a 15% increase attributed to climate change.

The relevant values have been extracted for the catchment of the proposed development. These have also been extrapolated (Figure 2) to include 1:0,5 year and 1:1 year recurrence intervals, and are set out in Tables 1 and 2.

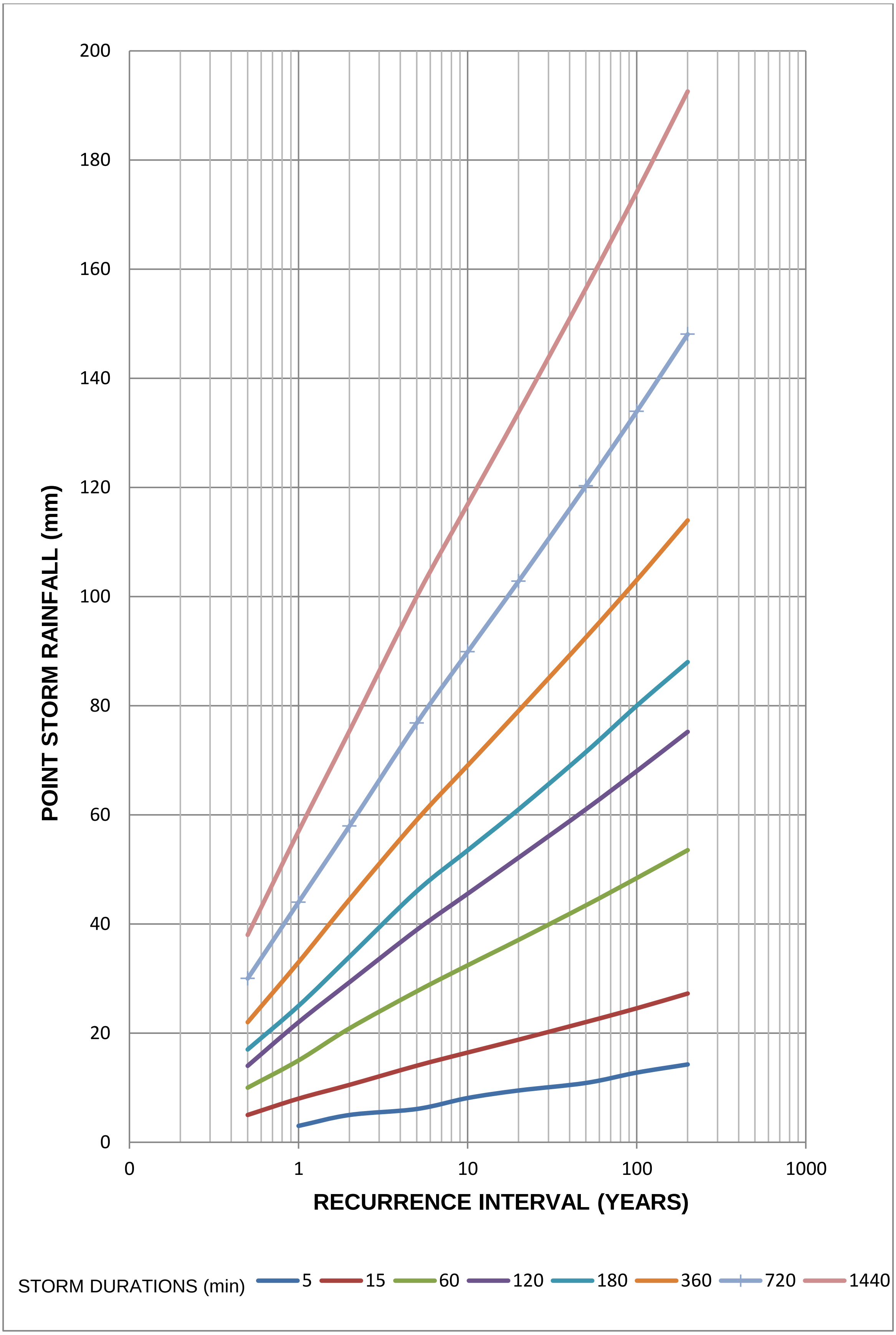


FIGURE 2: POINT STORM RAINFALL FOR OAKHURST INCORPORATING CLIMATE CHANGE EFFECT

TABLE 1: POINT STORM RAINFALL INTENSITIES FOR OAKHURST EXTRACTED

Return Period y	Event Duration/Rainfall (inc CC Factor)							
	Min 5	Min 15	Min 60	Min 120	Min 180	Min 360	Min 720	Min 1440
0.5	36.0	20.0	10.0	7.0	5.7	3.7	2.5	1.6
1	60.0	32.0	15.0	11.0	8.3	5.5	3.7	2.4
2	73.1	42.1	20.9	14.7	11.3	7.42	4.83	3.14
5	97.3	56.1	27.7	19.5	15.3	9.84	6.40	4.17
10	113.9	65.8	32.4	22.8	17.8	11.51	7.49	4.87
20	130.4	75.2	37.1	26.1	20.3	13.18	8.57	5.57
50	153.2	88.1	43.4	30.5	23.8	15.42	10.02	6.52
100	171.1	98.2	48.4	34.0	26.7	17.17	11.16	7.26
200	188.4	109.0	53.5	37.6	29.3	18.99	12.34	8.02

TABLE 2: POINT STORM RAINFALL FOR OAKHURST EXTRACTED FROM CCT DESIGN GRID INCORPORATING CLIMATE CHANGE FACTOR

Return Period y	Event Duration/Rainfall (inc CC Factor)							
	Min 5	Min 15	Min 60	Min 120	Min 180	Min 360	Min 720	Min 1440
0.50	3.0	5.0	10.0	14.0	17.0	22.0	30.0	38.0
1.00	5.0	8.0	15.0	22.0	25.0	33.0	44.0	57.0
2.00	6.1	10.5	20.9	29.3	34.0	44.5	58.0	75.4
5.00	8.1	14.0	27.7	38.9	46.0	59.1	76.8	100.0
10.00	9.5	16.4	32.4	45.5	53.5	69.1	89.9	116.9
20.00	10.9	18.8	37.1	52.2	61.0	79.1	102.8	133.7
50.00	12.8	22.0	43.4	61.0	71.5	92.5	120.3	156.5
100.00	14.3	24.6	48.4	68.0	80.0	103.0	133.9	174.2
200.00	15.7	27.3	53.5	75.2	88.0	114.0	148.1	192.6

Each of the data sets for a particular recurrence interval has been transformed into a 24 hour storm with a central peak and containing all the intensities listed in Table 1. These storms utilise the conservative assumption of no areal reduction of point intensities.

4.3. PRE-DEVELOPMENT CONDITIONS

The total catchment area of 2,28km^2 has been divided into internal and external sub-catchments for both pre-development and post-development conditions. The external sub-catchments are those external to the development area and which flow through or across it.

The subcatchments each with its relevant parameters are listed in Table 3.

A CN value of 70 was considered to be appropriate for the pre-development conditions taking into consideration the geological conditions, slopes and vegetation cover. The lag times are based on the slope and length of each of the sub-catchments.

The output from the HEC-HMS runs is set out in Annexure B.

4.4. POST-DEVELOPMENT CONDITIONS

As a result of the development of housing, roads and stormwater reticulation, the infiltration will be reduced and the peak and volume of runoff increased. These increases have been simulated by increasing the CN values in the developed areas to 85 and decreasing the basin lag based on the smoother surfaces and more efficient drainage systems.

The results from the HEC-HMS analysis are included in Annexure C.

The overall effect of these changes is shown by the simulated increase in peak flow in the main river channel (Table 5). The increases were found to be small for 1:1 year event, to negligible for the 1:100 year event. The reason for this is the reduced basin lag for the portion being developed, causes the runoff to occur more rapidly and therefore not coincide with the peak flow from the remainder of the catchment.

It is therefore considered that apart from the attenuation which will occur for the lower (1:0,5 and 1:1 year) recurrence intervals in the SUDS facilities, additional attenuation is not required.

TABLE 3: CATCHMENT PARAMETERS: POST-DEVELOPMENT CONDITION

CATCHMENT	1	2	3	4	5	6	7
Catchment area (km^2)	0.011	0.015	0.014	0.010	0.017	0.005	0.005
L (m)	100	130	140	110	240	80	110
Average slope (%)	8.00%	12.00%	12.00%	11.00%	5.00%	7.00%	7.00%
Average vel (m/s)	2	2.4	2.4	2.3	1.6	1.9	1.9
Travel time (min)	1	1	1	1	3	1	1
Basin Lag (min)	11	11	11	10	12	10	11
Soil group	C	C	C	C	C	C	C
Land use	Veld	Veld	Veld	Veld	Veld	Veld	Veld
Ronoff potential	good	good	good	good	good	good	good
CNf adjusted	70	70	70	70	70	70	70
SCS: S	108.86	108.86	108.86	108.86	108.86	108.86	108.86
SCS: c	0.10	0.10	0.10	0.10	0.10	0.10	0.10
SCS: Ia (mm)	10.89	10.89	10.89	10.89	10.89	10.89	10.89
CATCHMENT	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Catchment area (km^2)	0.012	0.012	0.007	0.007	0.009	0.008	0.013
L (m)	360	210	230	190	180	180	180
Average slope (%)	7.00%	9.00%	8.00%	7.00%	8.00%	12.00%	13.00%
Average vel (m/s)	2.1	2.4	2	1.9	2	2.4	2.5
Travel time (min)	3	1	2	2	2	1	1
Basin Lag (min)	12	11	11	11	11	11	11
Soil group	C	C	C	C	C	C	C
Land use	Veld	Veld	Veld	Veld	Veld	Veld	Veld
Ronoff potential	good	good	good	good	good	good	good
CNf adjusted	70	70	70	70	70	70	70
SCS: S	108.86	108.86	108.86	108.86	108.86	108.86	108.86
SCS: c	0.10	0.10	0.10	0.10	0.10	0.10	0.10
SCS: Ia (mm)	10.89	10.89	10.89	10.89	10.89	10.89	10.89
CATCHMENT	**15**	**16**	**17**	**18**	**20**		
Catchment area (km^2)	0.003	0.005	0.011	0.003	0.002		
L (m)	100	160	150	80	70		
Average slope (%)	15.00%	13.00%	11.00%	11.00%	10.00%		
Average vel (m/s)	2.7	2.5	2.3	2.3	2.2		
Travel time (min)	1	1	1	1	1		
Basin Lag (min)	10	11	11	10	10		
Soil group	C	C	C	C	C		
Land use	Veld	Veld	Veld	Veld	Veld		
Ronoff potential	good	good	good	good	good		
CNf adjusted	70	70	70	70	70		
SCS: S	108.86	108.86	108.86	108.86	108.86		
SCS: c	0.10	0.10	0.10	0.10	0.10		
SCS: Ia (mm)	10.89	10.89	10.89	10.89	10.89		
CATCHMENT	**EXT1**	**EXT2**	**EXT3**	**EXT4**	**EXT5**		
Catchment area (km^2)	0.261	0.214	1.145	0.298	0.192		
L (m)	430	690	1020	780	1000		
Average slope (%)	23.00%	47.00%	38.00%	16.00%	7.00%		
Average vel (m/s)	3.8	5.5	5	3.2	2.2		
Travel time (min)	2	2	3	4	8		
Basin Lag (min)	11	11	12	12	15		
Soil group	C	C	C	C	C		
Land use	Veld	Veld	Veld	Veld	Veld		
Ronoff potential	good	good	good	good	good		
CNf adjusted	70	70	70	70	70		
SCS: S	108.86	108.86	108.86	108.86	108.86		
SCS: c	0.10	0.10	0.10	0.10	0.10		
SCS: Ia (mm)	10.89	10.89	10.89	10.89	10.89		

TABLE 4: CATCHMENT PARAMETERS: POST-DEVELOPMENT CONDITION

CATCHMENT	1	2	3	4	5	6	7
Catchment area (km^2)	0.011	0.015	0.014	0.010	0.017	0.005	0.005
L (m)	100	130	140	110	240	80	110
Average slope (%)	8.00%	12.00%	12.00%	11.00%	5.00%	7.00%	7.00%
Average vel (m/s)	2	2.4	2.4	2.3	1.6	1.9	1.9
Travel time (min)	1	1	1	1	3	1	1
Basin Lag (min)	11	11	11	5	7	5	6
Soil group	C	C	C	C	C	C	C
Land use	Veld	Veld	Veld	Residential	Residential	Residential	Residential
Ronoff potential	good	good	good	good	good	good	good
CNf adjusted	70	70	70	85	85	85	85
SCS: S	108.86	108.86	108.86	44.82	44.82	44.82	44.82
SCS: c	0.10	0.10	0.10	0.10	0.10	0.10	0.10
SCS: Ia (mm)	10.89	10.89	10.89	4.48	4.48	4.48	4.48

CATCHMENT	8	9	10	11	12	13	14
Catchment area (km^2)	0.012	0.012	0.007	0.007	0.009	0.008	0.013
L (m)	360	210	230	190	180	180	180
Average slope (%)	7.00%	9.00%	8.00%	7.00%	8.00%	12.00%	13.00%
Average vel (m/s)	2.1	2.4	2	1.9	2	2.4	2.5
Travel time (min)	3	1	2	2	2	1	1
Basin Lag (min)	12	11	6	6	6	6	6
Soil group	C	C	C	C	C	C	C
Land use	Veld	Veld	Residential	Residential	Residential	Residential	Residential
Ronoff potential	good	good	good	good	good	good	good
CNf adjusted	70	70	85	85	85	85	85
SCS: S	108.86	108.86	44.82	44.82	44.82	44.82	44.82
SCS: c	0.10	0.10	0.10	0.10	0.10	0.10	0.10
SCS: Ia (mm)	10.89	10.89	4.48	4.48	4.48	4.48	4.48

CATCHMENT	15	16	17	18	20		
Catchment area (km^2)	0.003	0.005	0.011	0.003	0.002		
L (m)	100	160	150	80	70		
Average slope (%)	15.00%	13.00%	11.00%	11.00%	10.00%		
Average vel (m/s)	2.7	2.5	2.3	2.3	2.2		
Travel time (min)	1	1	1	1	1		
Basin Lag (min)	5	6	6	5	5		
Soil group	C	C	C	C	C		
Land use	Residential	Residential	Residential	Residential	Residential		
Ronoff potential	good	good	good	good	good		
CNf adjusted	85	85	85	85	85		
SCS: S	44.82	44.82	44.82	44.82	44.82		
SCS: c	0.10	0.10	0.10	0.10	0.10		
SCS: Ia (mm)	4.48	4.48	4.48	4.48	4.48		

CATCHMENT	EXT1	EXT2	EXT3	EXT4	EXT5		
Catchment area (km^2)	0.261	0.214	1.145	0.298	0.192		
L (m)	430	690	1020	780	1000		
Average slope (%)	23.00%	47.00%	38.00%	16.00%	7.00%		
Average vel (m/s)	3.8	5.5	5	3.2	2.2		
Travel time (min)	2	2	3	4	8		
Basin Lag (min)	11	11	12	12	15		
Soil group	C	C	C	C	C		
Land use	Veld	Veld	Veld	Veld	Veld		
Ronoff potential	good	good	good	good	good		
CNf adjusted	70	70	70	70	70		
SCS: S	108.86	108.86	108.86	108.86	108.86		
SCS: c	0.10	0.10	0.10	0.10	0.10		
SCS: Ia (mm)	10.89	10.89	10.89	10.89	10.89		

TABLE 5: COMPARISON OF PRE- AND POST-DEVELOPMENT PEAK FLOW WITHOUT SUDS (REACH 14)

RECURRENCE INTERVALS	PEAK FLOW IN MAIN RIVER (REACH 14)			
	PRE-DEV (m3/s)	POST-DEV (m3/s)	INCREASE (m3/s)	(%)
1:0,5 yr	1.33	1.40	0.07	5.19%
1:1 yr	4.00	4.12	0.11	2.8%
1:10 yr	16.65	16.78	0.14	0.8%
1:50 yr	26.74	27.84	0.10	0.4%
1:100 yr	31.55	31.82	0.08	0.2%
Note: SUDS are introduced to mitigate the increased flow peaks.				

5. STORMWATER MANAGEMENT PLAN

5.1. GENERAL

In order to adequately manage the stormwater within the development, appropriate measures must be taken to convey the runoff from outside of the development, safely and efficiently through the development.

Secondly mitigating measures must be put in place to ensure that the areas which lie downstream of the development are not negatively impacted both from a quantity and quality perspective.

The functions of the stormwater management plan are to ensure safe conveyance of, and pollutant removal from, the stormwater leaving the property. This is achieved through the implementation of sustainable urban drainage systems (SUDS).

5.2. MANAGEMENT OF EXTERNAL STORMWATER

There is a main stream which flows through the property from south to north and two smaller tributaries. The confluence of the three streams is midway through the development and immediately to the south of the reserve for the planned Main Road no. 12.

A road crossing is located adjacent to the reserve for the proposed Main Road no. 12 and there is one road crossing on each of the two tributaries.

These streams will therefore flow freely through the development without obstruction except for the culverts. Preliminary sizing of the culverts is given in Table 6.

TABLE 6: PROPOSED CULVERTS CROSSING STREAMS

STREAM	DESIGN CAPACITY FOR 1:50 YEAR FLOW PEAK (m3/s)	PROPOSED CULVERT
1	23,3	3/2100mm x 1500mm
2	4,0	1/1500mm x 1200mm
3	3,2	1/1200mm x 1200mm

The proposed erf layout is set back 30m from top of bank on the main stream and 20m wide strips of open space are provided along the two small tributaries.

Apart from the flow which is already in the streams at the southern boundary of the development, there will be overland flow from the mountain slopes reaching the upper boundaries of the erven along that edge. The erven affected in any way are 37, 38, 39, 63, 64, 65, 67 and 68.

In order to protect these erven from stormwater it is proposed to provide collector channels along the boundary which will convey the runoff to the nearest of the three streams. It is planned to provide those collectors in the fire break and if possible as part of the track which is to be provided for fire protection vehicle access.

The details of the proposed collector channels are provided in Table 7.

TABLE 7: MOUNTAIN SLOPE OVERLAND FLOW COLLECTOR CHANNELS

CHANNEL NO.	ADJACENT TO ERVEN	DISCHARGING TO STREAM NO.	ESTIMATED PEAK FLOW 1:50 yr	CHANNEL REQUIRED FOR 1:50 YR FLOW
1	67, 68	2	0.13	Type 1
2	64, 65	2	0.07	Type 1
3	63, 64	1	0.30	Type 2
4	37, 38, 39	1	0.09	Type 1
NOTES Type 1: Grass block lining; 500mm base, 2:1 (H:V) side slopes, depth 400mm Type 2: Grass block lining; 500mm base, 2:1 (H:V) side slopes, depth 500mm				

Some runoff will enter the property from the side of Blue Valley Road. This runoff will be collected in a collector channel to be constructed along the eastern edge of the property. Flow from this channel will be directed down to the main stream at intervals as indicated on drawing MC145-C900.

5.3. MANAGEMENT OF INTERNAL STORMWATER

It is proposed to utilize enhanced dry swales (Figure 3) in a number of areas as shown on drawing MC154-C900 Stormwater Management Plan.

The swales are to be lined with indigenous Cynodon grass. The filtration media below the surface has a high permeability and a storage capacity.

At the head of each of the swales will a 0,3 m deep forebay with a grid outlet into the swale will trap litter and suspended solids. A gabion wall between the forebay and the swale will permit water remaining in the forebay to infiltrate into the filtration media of the swale.

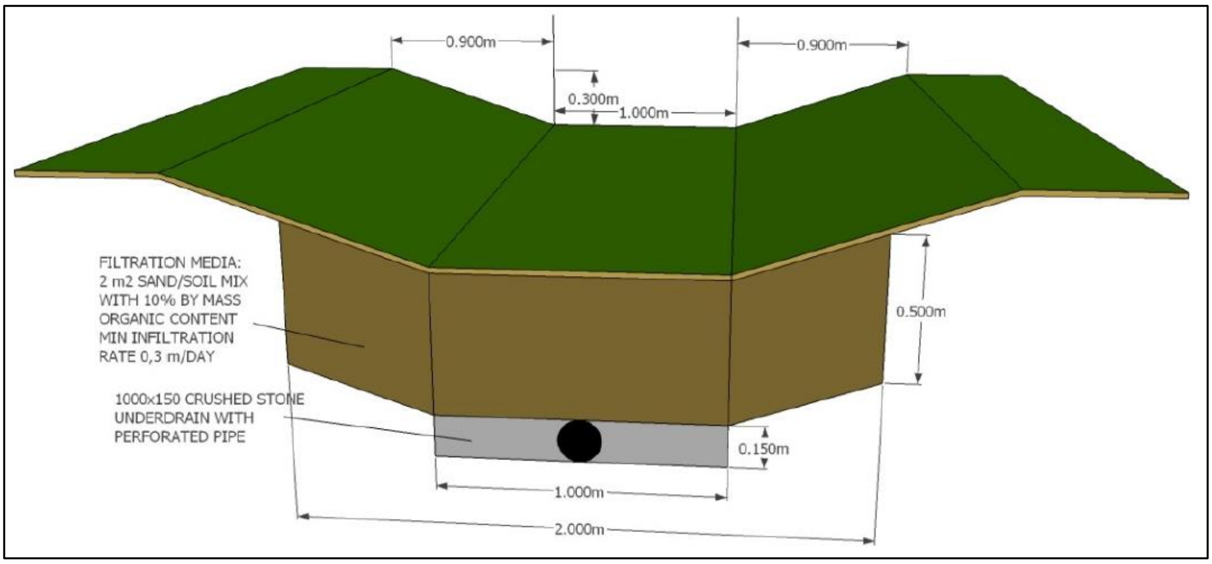
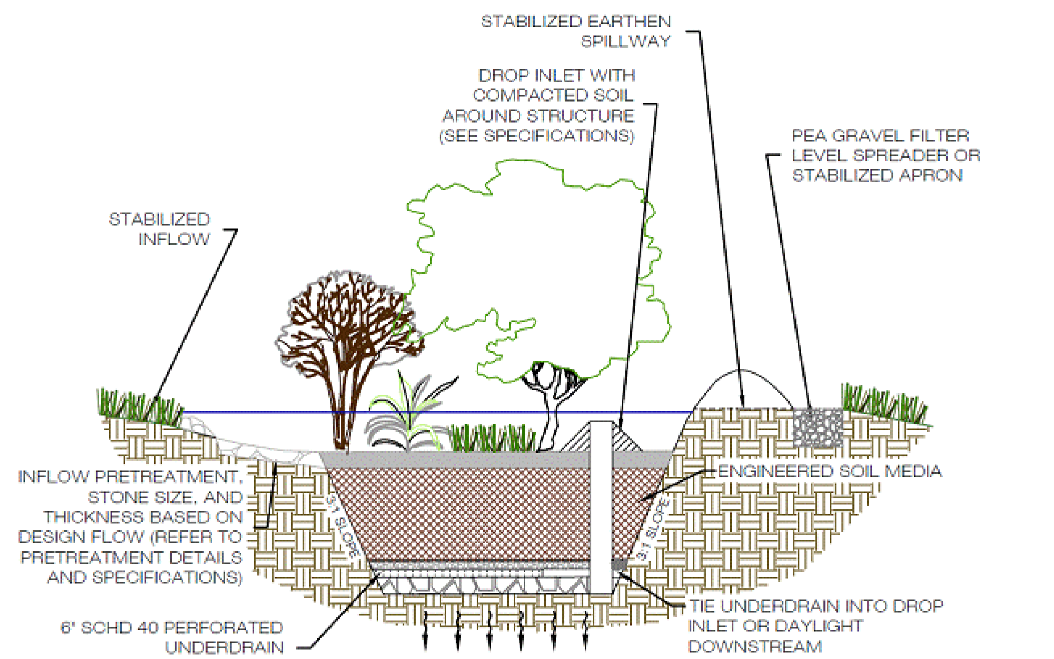


FIGURE 3: CROSS SECTION OF THE PROPOSED ENHANCED DRY GRASS SWALE

On a number of the larger erven it is proposed that bio-retention units be constructed. These must be located on the erven to so as to receive the runoff from roofs, driveways and parking areas. A typical detail is shown in Figure 4. These will be sized according to the method in Municipal Stormwater Management (Debo & Reese, 2nd ed.)



NOTES:

1 Extract from Municipal Stormwater Management, 2nd ed, Debo & Reese

2 To be utilised at swimming pool/gym.

FIGURE 4: TYPICAL BIO-RETENTION FACILITY

5.4. POLLUTANT MASS BALANCE

In order to assess the effectiveness of the treatment facilities in removing the pollutant load (SS and TP),a pollutant mass balance has been computed.

The anticipated pollutants emanating from the development, and the anticipated reduction in total suspended solids (TSS) and total phosphorus (TP) for each of the SUDS components has been computed.

The overall improvement in stormwater quality for the site as a whole was found to meet the required 80% TSS reduction and exceed the required 45% TP reduction water quality objectives set by City of Cape Town.

A summary of these calculations are is set out in Tables 8-10 below.

TABLE 8: ENHANCED DRY SWALES: DIMENSIONS

ENHANCED DRY SWALE NO. (EDS)	SUB-BASINS	LENGTH (m)
1	1, 2, 3, 6, 7	342
2	10, 11	34
3		100
4		102
5	12, 13, 14, 15	39
6		146
7		123
8	17	150
9	16, 18, 20	230
TOTALS		1266

TABLE 9: POLLUTANT LOADS IN RUNOFF						
SUB-CATCH-MENT	24H RUNOFF: 1:0,5 YR (m^3)	SUB-CATCHMENT TYPE	POLLUTANT CONC TOTAL INCOMING (mg/l)		POLLUTANT LOAD TOTAL (kg)	
			TSS	TP	TSS	TP
	POLLUTANT ALL URBAN (mg/l)		**120**	**0.31**		
Swale 1						
Subbasin-1	61	Rural	100	0.2	6.10	0.01
Subbasin-2	80	Rural	100	0.2	8.00	0.02
Subbasin-3	75	Rural	100	0.2	7.50	0.02
Subbasin-6	78	Residential	120	0.31	9.36	0.02
Subbasin-7	66	Residential	120	0.31	7.92	0.02
SUB-TOTAL	360		108	0.244	38.88	0.09
On-site bio-retention						
Subbasin-4	137	Residential	120	0.31	16.44	0.04
Subbasin-5	241	Residential	120	0.31	28.92	0.07
SUB-TOTAL	378		120	0.31	45.36	0.12
Rural						
Subbasin-8	65	Rural	100	0.2	6.50	0.01
Subbasin-9	66	Rural	100	0.2	6.60	0.01
SUB-TOTAL	131		100	0.2	13.10	0.03
Swales 2, 3, 4						
Subbasin-10	103	Residential	120	0.31	12.36	0.03
Subbasin-11	99	Residential	120	0.31	11.88	0.03
SUB-TOTAL	202		120	0.31	24.24	0.06
Swales 5, 6, 7						
Subbasin-12	134	Residential	120	0.31	16.08	0.04
Subbasin-13	110	Residential	120	0.31	13.20	0.03
Subbasin-14	187	Residential	120	0.31	22.44	0.06
Subbasin-15	47	Residential	120	0.31	5.64	0.01
SUB-TOTAL	478		120	0.31	57.36	0.15
Swale 8						
Subbasin-17	154	Residential	120	0.31	18.48	0.05
SUB-TOTAL	154		120	0.31	18.48	0.05
Swale 9						
Subbasin-16	76	Residential	120	0.31	9.12	0.02
Subbasin-18	43	Residential	120	0.31	5.16	0.01
Subbasin-20	31	Residential	120	0.31	3.72	0.01
SUB-TOTAL	150		120	0.31	18.0	0.05
TOTAL					215.42	0.54
NOTE:						
Pollutant load determined from typical concentration from land use (Australian Runoff Quality).						

TABLE 10: POLLUTANT MASS BALANCE

	SUB-CATCHMENT SET							TOTAL	
	1	2	3	4	5	6	7		
Sub-catchments	1, 2, 3, 6, 7	4, 5	8, 9	10, 11	12, 13, 14, 15	17	16, 18, 20		
1:0,5 year 24 h runoff (m^3)	360	378	131	202	478	154	150		
Average pollutant concentration									
TSS (mg/l)	108.000	120.000	100.000	120.000	120.000	120.000	120.000		
TP (mg/l)	0.244	0.310	0.200	0.310	0.310	0.310	0.310		
Pollutant loads									
TSS (kg)	38.880	45.360	13.100	24.240	57.360	18.480	18.000	215.420	
TP (kg)	0.088	0.117	0.026	0.063	0.148	0.048	0.047	0.536	
Forebay pollutant reduction									
TSS (%)	30%			30%	30%	30%	30%		
TP (%)	0%			0%	0%	0%	0%		
TSS (kg)	11.664			7.272	17.208	5.544	5.400		
TP (kg)	0.000			0.000	0.000	0.000	0.000		
Balance									
TSS (kg)	27.216	45.360	13.100	16.968	40.152	12.936	12.600		
TP (kg)	0.088	0.117	0.026	0.063	0.148	0.048	0.047		
Swale pollutant reduction									
TSS (%)	80%			80%	80%	80%	80%		
TP (%)	50%			50%	50%	50%	50%		
TSS (kg)	21.773			13.574	32.122	10.349	10.080		
TP (kg)	0.044			0.031	0.074	0.024	0.023		
Balance									
TSS (kg)	5.443	45.360	13.100	3.394	8.030	2.587	2.520		
TP (kg)	0.044	0.117	0.026	0.031	0.074	0.024	0.023		
Bio retention pollutant reduction									
TSS (%)		80%	0%						
TP (%)		50%	0%						
TSS (kg)		36.288	0.000						
TP (kg)		0.059	0.000						
Balance									
TSS (kg)	5.443	9.072	13.100	3.394	8.030	2.587	2.520	44.146	
TP (kg)	0.044	0.059	0.026	0.031	0.074	0.024	0.023	0.281	
OVERALL POLLUTANT REDUCTION									
TSS (%)									80%
TP (%)									48%

5.5. MAINTENANCE OF THE STORMWATER SYSTEM

5.5.1 ENHANCED DRY SWALES

Litter and sediment must be removed from the forebay on a regular basis.

The Cynodon grassed base and slopes should be mowed at a high level on a regular basis.

The perforated drainage pipe should be kept clear and rodded if necessary to ensure continual drainage of the filter media.

5.5.2 LITTER AND SEDIMENT TRAPS

Litter and sediment must be removed from the forebay on a regular basis. The frequency may commence at three-monthly and be adjusted based on experience.

6. CONCLUSIONS

6.1 EXISTING STORMWATER CONDITIONS

Consolidated erf A/8343 and R/2224 has an area of 78,2 ha of which it is proposed to develop 20,2 ha as a low density residential area.

There is no development or stormwater infrastructure on the site at present. A main water course with two smaller tributaries flow through the site from south to north towards Hout Bay Main Road. The catchment has an area of 2,28 km^2.

The slopes of the area to be developed range from 5% to 15%.

The 1:50 and 1:100 year floodlines have been determined by others and are shown on the stormwater management plan.

A wetland has been designated and is its position is also indicated on the stormwater management plan.

6.2 PROPOSED DEVELOPMENT

The proposed land use is single residential as shown on the sub-division drawing (E R/2224 HBAY SUBDIV/06 PROPOSED SUBDIVISION OF CONSOLIDATED ERF A/8343 AND R/2224, HOUT BAY: SKETCH PLAN).

6.3 STORMWATER MANAGEMENT PLAN (SWMP)

The SWMP is required to demonstrate how the objectives of the City's Stormwater Policy are to be achieved.

In the report it is shown that the quality objectives will be met by means of a SWMP system in which a treatment train comprising of an enhanced dry grassed swale, litter and sediment traps in the swale and bio-retention units.

The runoff peaks will be slightly attenuated by the swales however it is shown that because of the configuration of the catchment the increase in peak flow due to the development will be negligible and attenuation, such as by ponds, would not be required.

Collector channels are required along the upper boundaries of the development in order to control the overland runoff from the mountain slopes. These channels will be accessible from the proposed fire truck access roads.

6.4 MAINTENANCE OF SUDS

Regular scheduled maintenance of the stormwater system as described in Section 5 is essential in order to ensure its long term effectiveness.

G A McGILL Pr Eng

2014-09-05

ANNEXURE A

CRITERIA FOR ACHIEVING SUDS OBJECTIVES EXTRACT FROM*MANAGEMENT OF URBAN STORMWATER IMPACTS POLICY*

27 MAY 2009

C 58/05/09

ANNEXURE: INTERIM CRITERIA FOR ACHIEVING SUSTAINABLE URBAN DRAINAGE SYSTEM OBJECTIVES IN VARIOUS DEVELOPMENT SCENARIOS

SUDS **OBJECTIVES**	**Greenfield Developments** ***and*** **Brownfield and Existing Development Sites located in catchments of sensitive receiving water systems**	**Brownfield and Existing Development Sites** **> 50 000 m^2**	**Brownfield and Existing Development Sites** **4000 m^2 – 50 000 m^2** ***and*** **Total impervious area (exist & new) > 15% of site**	**Brownfield and Existing Development Sites** **< 4000 m^2** ***and*** **Total impervious area (exist and new) > 600m^2**
IMPROVE QUALITY OF RUNOFF *Remove pollutants through combination of reducing and/or disconnecting impervious areas, and the use of BMPs which infiltrate or capture and treat stormwater runoff*	Design storm event for water quality treatment: 1/2-year RI, 24 h storm			
	Pollutant removal target: Reduction of post-development annual stormwater pollutant load discharged from dev. site: SS & TP - reduce to undeveloped catchment levels, or SS - 80% reduction TP - 45% reduction *whichever requires higher level of treatment*	Pollutant removal target: On-site reduction of post-development annual stormwater pollutant load discharged from developmenrt site: SS - 80% reduction TP - 45% reduction	Pollutant removal target: Combination of on-site and regional off-site measures to achieve target reductions: SS - 80% reduction TP - 45% reduction	On-site stormwater treatment not required but encouraged where practicable. Regional off-site treatment measures to achieve target reductions: SS - 80% reduction TP - 45% reduction
	All developments are required to trap litter, oil, grease at source			

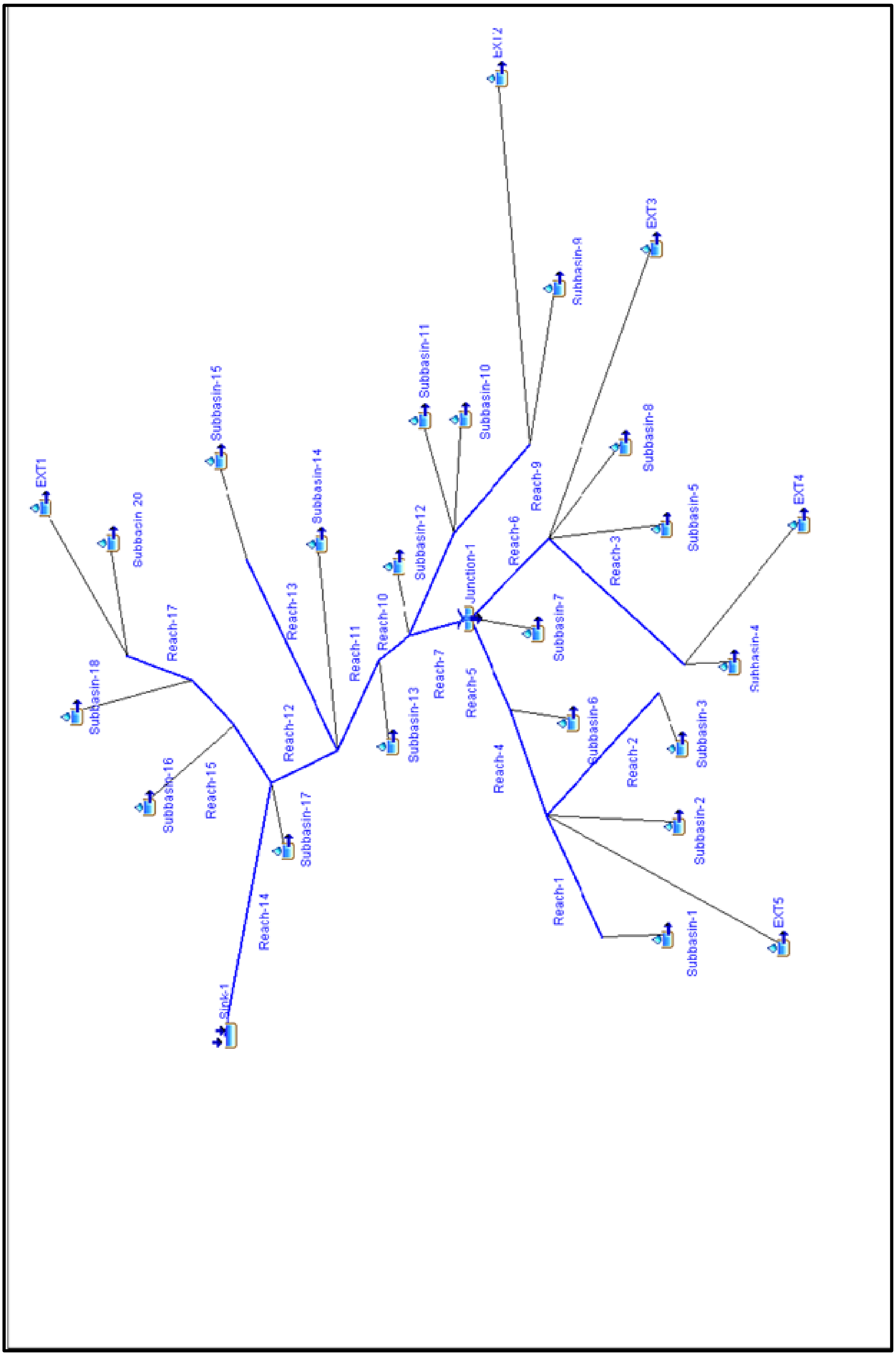
Table continued on next page….

SUDS OBJECTIVES		Greenfield Developments *and* Brownfield and Existing Development Sites located in catchments of sensitive receiving water systems	Brownfield and Existing Development Sites > 50 000 m^2	Brownfield and Existing Development Sites 4000 m^2 – 50 000 m^2 *and* Total impervious area (exist & new) > 15% of site	Brownfield and Existing Development Sites < 4000 m^2 *and* Total impervious area (exist and new) > 600m^2
CONTROL QUANTITY AND RATE OF RUNOFF	*Protect the stability of downstream channels*	24 hour extended detention of the1-year RI, 24h storm event	24 hour extended detention of the1-year RI, 24h storm event	Combination of on-site and regional off-site measures to achieve requirements as for development sites >50 000m^2	On-site runoff control measures not required but encouraged where practicable Regional off-site runoff control measures to be provided to achieve requirements as for development sites > 50 000m^2
	Protect downstream properties from fairly frequent nuisance floods	Up to 10-year RI peak flow reduced to pre-development level	Up to 10-year RI peak flow reduced to pre-development level		
	Protect floodplain developments and floodplains from adverse impacts of extreme floods	Up to 50-year RI peak flow reduced to existing development levels. Evaluate the effects of the 100-year RI storm event on the stormwater management system, adjacent property, and downstream facilities and property. Manage the impacts through detention controls and / or floodplain management	Up to 50-year RI peak flow reduced to existing development levels. Evaluate the effects of the 100-year RI storm event on the stormwater management system, adjacent property, and downstream facilities and property. Manage the impacts through detention controls and / or floodplain management		
		Developments adjacent to floodplains must adhere to the requirements of the Floodplain and River Corridor Management Policy			
ENCOURAGE NATURAL GROUNDWATER RECHARGE		Where appropriate, site specific requirements to be considered in consultation with Council			

ANNEXURE B

HEC-HMS OUTPUT FOR THE PRE-DEVELOPMENT CONDITION

HEC-HMS DIAGRAM



1:0,5 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	0.177	02Jan2013, 00:14	1.396
EXT2	0.214	0.145	02Jan2013, 00:14	1.146
EXT3	1.145	0.746	02Jan2013, 00:16	6.121
EXT4	0.298	0.194	02Jan2013, 00:16	1.593
EXT5	0.192	0.113	02Jan2013, 00:20	1.022
Junction-1	1.723	1.058	02Jan2013, 00:22	9.173
Reach-1	0.011	0.008	02Jan2013, 00:20	0.060
Reach-10	1.973	1.208	02Jan2013, 00:32	10.442
Reach-11	1.981	1.204	02Jan2013, 00:38	10.451
Reach-12	1.997	1.208	02Jan2013, 00:42	10.506
Reach-13	0.003	0.002	02Jan2013, 00:18	0.018
Reach-14	2.280	1.333	02Jan2013, 00:48	11.957
Reach-15	0.271	0.179	02Jan2013, 00:30	1.439
Reach-16	0.266	0.178	02Jan2013, 00:24	1.415
Reach-17	0.263	0.177	02Jan2013, 00:18	1.403
Reach-2	0.014	0.010	02Jan2013, 00:20	0.075
Reach-3	0.308	0.200	02Jan2013, 00:20	1.639
Reach-4	0.232	0.139	02Jan2013, 00:24	1.233
Reach-5	0.237	0.142	02Jan2013, 00:30	1.258
Reach-6	1.481	0.944	02Jan2013, 00:22	7.891
Reach-7	1.723	1.054	02Jan2013, 00:28	9.145
Reach-8	0.241	0.161	02Jan2013, 00:24	1.280
Reach-9	0.227	0.152	02Jan2013, 00:20	1.209
Sink-1	2.280	1.333	02Jan2013, 00:48	11.957
Subbasin-1	0.011	0.008	02Jan2013, 00:14	0.061
Subbasin-10	0.007	0.005	02Jan2013, 00:14	0.038
Subbasin-11	0.007	0.005	02Jan2013, 00:14	0.037
Subbasin-12	0.009	0.006	02Jan2013, 00:14	0.050
Subbasin-13	0.008	0.005	02Jan2013, 00:14	0.041
Subbasin-14	0.013	0.009	02Jan2013, 00:14	0.070
Subbasin-15	0.003	0.002	02Jan2013, 00:12	0.018
Subbasin-16	0.005	0.004	02Jan2013, 00:14	0.029
Subbasin-17	0.011	0.007	02Jan2013, 00:14	0.058
Subbasin-18	0.003	0.002	02Jan2013, 00:12	0.016
Subbasin-2	0.015	0.010	02Jan2013, 00:14	0.080
Subbasin-20	0.002	0.002	02Jan2013, 00:12	0.012
Subbasin-3	0.014	0.010	02Jan2013, 00:14	0.075
Subbasin-4	0.010	0.007	02Jan2013, 00:12	0.051
Subbasin-5	0.017	0.011	02Jan2013, 00:16	0.090
Subbasin-6	0.005	0.004	02Jan2013, 00:12	0.029
Subbasin-7	0.005	0.003	02Jan2013, 00:14	0.025
Subbasin-8	0.012	0.008	02Jan2013, 00:16	0.065
Subbasin-9	0.012	0.008	02Jan2013, 00:14	0.066

1:1 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.2609	0.541	02Jan2013, 00:12	3.547
EXT2	0.21415	0.444	02Jan2013, 00:12	2.911
EXT3	1.14477	2.29	02Jan2013, 00:14	15.552
EXT4	0.29796	0.596	02Jan2013, 00:14	4.048
EXT5	0.19168	0.344	02Jan2013, 00:18	2.598
Junction-1	1.72321	3.211	02Jan2013, 00:22	23.317
Reach-1	0.01131	0.023	02Jan2013, 00:18	0.153
Reach-10	1.97319	3.654	02Jan2013, 00:30	26.557
Reach-11	1.98091	3.659	02Jan2013, 00:36	26.586
Reach-12	1.99734	3.644	02Jan2013, 00:40	26.732
Reach-13	0.0033	0.007	02Jan2013, 00:18	0.045
Reach-14	2.2795	4.005	02Jan2013, 00:46	30.432
Reach-15	0.2714	0.552	02Jan2013, 00:28	3.659
Reach-16	0.26607	0.545	02Jan2013, 00:24	3.597
Reach-17	0.26306	0.546	02Jan2013, 00:18	3.566
Reach-2	0.01403	0.029	02Jan2013, 00:18	0.19
Reach-3	0.30753	0.611	02Jan2013, 00:20	4.167
Reach-4	0.2319	0.424	02Jan2013, 00:24	3.134
Reach-5	0.23734	0.429	02Jan2013, 00:28	3.198
Reach-6	1.48126	2.878	02Jan2013, 00:20	20.056
Reach-7	1.72321	3.201	02Jan2013, 00:26	23.252
Reach-8	0.24063	0.49	02Jan2013, 00:22	3.254
Reach-9	0.22654	0.47	02Jan2013, 00:18	3.071
Sink-1	2.2795	4.005	02Jan2013, 00:46	30.432
Subbasin-1	0.01131	0.023	02Jan2013, 00:12	0.154
Subbasin-10	0.00719	0.015	02Jan2013, 00:12	0.098
Subbasin-11	0.0069	0.014	02Jan2013, 00:12	0.094
Subbasin-12	0.00935	0.019	02Jan2013, 00:12	0.127
Subbasin-13	0.00772	0.016	02Jan2013, 00:12	0.105
Subbasin-14	0.01313	0.027	02Jan2013, 00:12	0.179
Subbasin-15	0.0033	0.007	02Jan2013, 00:12	0.045
Subbasin-16	0.00533	0.011	02Jan2013, 00:12	0.072
Subbasin-17	0.01076	0.022	02Jan2013, 00:12	0.146
Subbasin-18	0.00301	0.007	02Jan2013, 00:12	0.041
Subbasin-2	0.01488	0.031	02Jan2013, 00:12	0.202
Subbasin-20	0.00216	0.005	02Jan2013, 00:12	0.029
Subbasin-3	0.01403	0.029	02Jan2013, 00:12	0.191
Subbasin-4	0.00957	0.021	02Jan2013, 00:12	0.13
Subbasin-5	0.01686	0.034	02Jan2013, 00:14	0.229
Subbasin-6	0.00544	0.012	02Jan2013, 00:12	0.074
Subbasin-7	0.00461	0.01	02Jan2013, 00:12	0.063
Subbasin-8	0.0121	0.024	02Jan2013, 00:14	0.164
Subbasin-9	0.01239	0.026	02Jan2013, 00:12	0.168

1:10 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	2.227	02Jan2013, 00:12	13.547
EXT2	0.214	1.828	02Jan2013, 00:12	11.119
EXT3	1.145	9.438	02Jan2013, 00:14	59.405
EXT4	0.298	2.456	02Jan2013, 00:14	15.462
EXT5	0.192	1.428	02Jan2013, 00:18	9.929
Junction-1	1.723	13.288	02Jan2013, 00:22	89.135
Reach-1	0.011	0.097	02Jan2013, 00:18	0.586
Reach-10	1.973	15.182	02Jan2013, 00:30	101.628
Reach-11	1.981	15.171	02Jan2013, 00:36	101.796
Reach-12	1.997	15.153	02Jan2013, 00:40	102.412
Reach-13	0.003	0.029	02Jan2013, 00:18	0.171
Reach-14	2.280	16.646	02Jan2013, 00:46	116.646
Reach-15	0.271	2.271	02Jan2013, 00:28	13.999
Reach-16	0.266	2.242	02Jan2013, 00:22	13.754
Reach-17	0.263	2.241	02Jan2013, 00:18	13.628
Reach-2	0.014	0.120	02Jan2013, 00:18	0.727
Reach-3	0.308	2.518	02Jan2013, 00:18	15.923
Reach-4	0.232	1.757	02Jan2013, 00:24	11.982
Reach-5	0.237	1.784	02Jan2013, 00:28	12.237
Reach-6	1.481	11.898	02Jan2013, 00:20	76.659
Reach-7	1.723	13.280	02Jan2013, 00:26	88.934
Reach-8	0.241	2.021	02Jan2013, 00:22	12.440
Reach-9	0.227	1.929	02Jan2013, 00:18	11.736
Sink-1	2.280	16.646	02Jan2013, 00:46	116.646
Subbasin-1	0.011	0.097	02Jan2013, 00:12	0.587
Subbasin-10	0.007	0.061	02Jan2013, 00:12	0.373
Subbasin-11	0.007	0.059	02Jan2013, 00:12	0.358
Subbasin-12	0.009	0.080	02Jan2013, 00:12	0.485
Subbasin-13	0.008	0.066	02Jan2013, 00:12	0.401
Subbasin-14	0.013	0.112	02Jan2013, 00:12	0.682
Subbasin-15	0.003	0.029	02Jan2013, 00:12	0.171
Subbasin-16	0.005	0.046	02Jan2013, 00:12	0.277
Subbasin-17	0.011	0.092	02Jan2013, 00:12	0.559
Subbasin-18	0.003	0.027	02Jan2013, 00:12	0.156
Subbasin-2	0.015	0.127	02Jan2013, 00:12	0.773
Subbasin-20	0.002	0.019	02Jan2013, 00:12	0.112
Subbasin-3	0.014	0.120	02Jan2013, 00:12	0.728
Subbasin-4	0.010	0.085	02Jan2013, 00:12	0.497
Subbasin-5	0.017	0.139	02Jan2013, 00:14	0.875
Subbasin-6	0.005	0.049	02Jan2013, 00:12	0.283
Subbasin-7	0.005	0.039	02Jan2013, 00:12	0.239
Subbasin-8	0.012	0.100	02Jan2013, 00:14	0.628
Subbasin-9	0.012	0.106	02Jan2013, 00:12	0.643

1:50 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	3.588	02Jan2013, 00:12	21.584
EXT2	0.214	2.945	02Jan2013, 00:12	17.716
EXT3	1.145	15.178	02Jan2013, 00:14	94.655
EXT4	0.298	3.950	02Jan2013, 00:14	24.637
EXT5	0.192	2.294	02Jan2013, 00:18	15.823
Junction-1	1.723	21.373	02Jan2013, 00:20	142.061
Reach-1	0.011	0.156	02Jan2013, 00:18	0.933
Reach-10	1.973	24.432	02Jan2013, 00:30	162.025
Reach-11	1.981	24.377	02Jan2013, 00:36	162.320
Reach-12	1.997	24.381	02Jan2013, 00:40	163.331
Reach-13	0.003	0.047	02Jan2013, 00:18	0.272
Reach-14	2.280	26.740	02Jan2013, 00:46	186.060
Reach-15	0.271	3.650	02Jan2013, 00:28	22.316
Reach-16	0.266	3.611	02Jan2013, 00:22	21.921
Reach-17	0.263	3.604	02Jan2013, 00:18	21.718
Reach-2	0.014	0.193	02Jan2013, 00:18	1.158
Reach-3	0.308	4.056	02Jan2013, 00:18	25.376
Reach-4	0.232	2.822	02Jan2013, 00:24	19.098
Reach-5	0.237	2.869	02Jan2013, 00:28	19.507
Reach-6	1.481	19.135	02Jan2013, 00:20	122.172
Reach-7	1.723	21.355	02Jan2013, 00:26	141.765
Reach-8	0.241	3.253	02Jan2013, 00:22	19.827
Reach-9	0.227	3.102	02Jan2013, 00:18	18.703
Sink-1	2.280	26.740	02Jan2013, 00:46	186.060
Subbasin-1	0.011	0.156	02Jan2013, 00:12	0.936
Subbasin-10	0.007	0.099	02Jan2013, 00:12	0.595
Subbasin-11	0.007	0.095	02Jan2013, 00:12	0.571
Subbasin-12	0.009	0.129	02Jan2013, 00:12	0.774
Subbasin-13	0.008	0.106	02Jan2013, 00:12	0.639
Subbasin-14	0.013	0.181	02Jan2013, 00:12	1.086
Subbasin-15	0.003	0.047	02Jan2013, 00:12	0.273
Subbasin-16	0.005	0.073	02Jan2013, 00:12	0.441
Subbasin-17	0.011	0.148	02Jan2013, 00:12	0.890
Subbasin-18	0.003	0.043	02Jan2013, 00:12	0.249
Subbasin-2	0.015	0.205	02Jan2013, 00:12	1.231
Subbasin-20	0.002	0.031	02Jan2013, 00:12	0.179
Subbasin-3	0.014	0.193	02Jan2013, 00:12	1.161
Subbasin-4	0.010	0.137	02Jan2013, 00:12	0.792
Subbasin-5	0.017	0.224	02Jan2013, 00:14	1.394
Subbasin-6	0.005	0.078	02Jan2013, 00:12	0.450
Subbasin-7	0.005	0.063	02Jan2013, 00:12	0.381
Subbasin-8	0.012	0.160	02Jan2013, 00:14	1.000
Subbasin-9	0.012	0.170	02Jan2013, 00:12	1.025

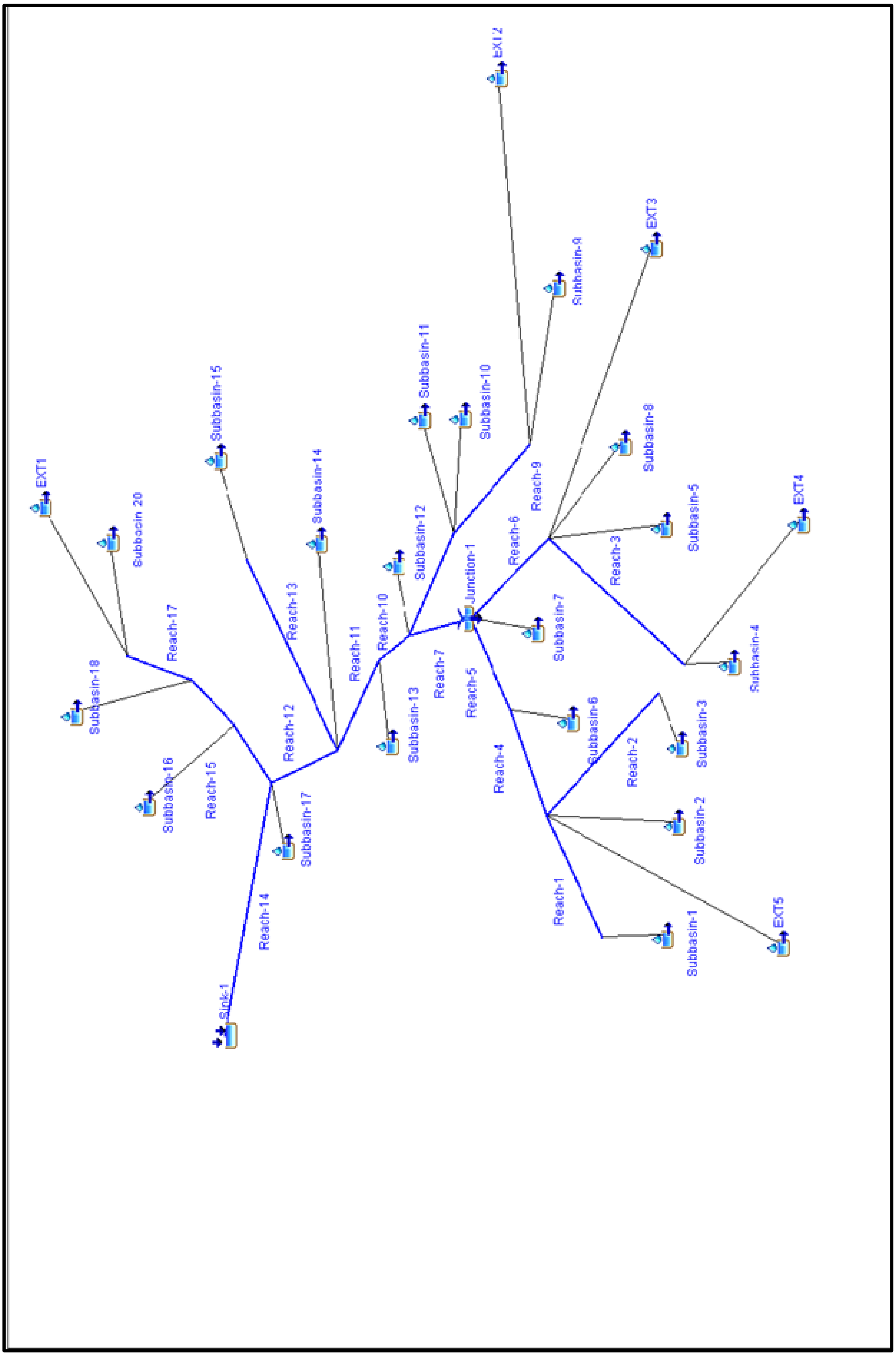
1:100 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	4.236	02Jan2013, 00:12	25.393
EXT2	0.214	3.477	02Jan2013, 00:12	20.843
EXT3	1.145	17.911	02Jan2013, 00:14	111.359
EXT4	0.298	4.662	02Jan2013, 00:14	28.985
EXT5	0.192	2.707	02Jan2013, 00:18	18.617
Junction-1	1.723	25.234	02Jan2013, 00:20	167.145
Reach-1	0.011	0.184	02Jan2013, 00:18	1.098
Reach-10	1.973	28.839	02Jan2013, 00:30	190.655
Reach-11	1.981	28.761	02Jan2013, 00:36	191.013
Reach-12	1.997	28.779	02Jan2013, 00:40	192.214
Reach-13	0.003	0.056	02Jan2013, 00:18	0.321
Reach-14	2.280	31.548	02Jan2013, 00:46	218.973
Reach-15	0.271	4.307	02Jan2013, 00:28	26.258
Reach-16	0.266	4.263	02Jan2013, 00:22	25.792
Reach-17	0.263	4.252	02Jan2013, 00:18	25.552
Reach-2	0.014	0.228	02Jan2013, 00:18	1.362
Reach-3	0.308	4.789	02Jan2013, 00:18	29.856
Reach-4	0.232	3.329	02Jan2013, 00:24	22.471
Reach-5	0.237	3.386	02Jan2013, 00:28	22.954
Reach-6	1.481	22.581	02Jan2013, 00:20	143.743
Reach-7	1.723	25.201	02Jan2013, 00:26	166.806
Reach-8	0.241	3.841	02Jan2013, 00:22	23.328
Reach-9	0.227	3.661	02Jan2013, 00:18	22.004
Sink-1	2.280	31.548	02Jan2013, 00:46	218.973
Subbasin-1	0.011	0.184	02Jan2013, 00:12	1.101
Subbasin-10	0.007	0.117	02Jan2013, 00:12	0.700
Subbasin-11	0.007	0.112	02Jan2013, 00:12	0.672
Subbasin-12	0.009	0.152	02Jan2013, 00:12	0.910
Subbasin-13	0.008	0.125	02Jan2013, 00:12	0.751
Subbasin-14	0.013	0.213	02Jan2013, 00:12	1.278
Subbasin-15	0.003	0.056	02Jan2013, 00:12	0.321
Subbasin-16	0.005	0.087	02Jan2013, 00:12	0.519
Subbasin-17	0.011	0.175	02Jan2013, 00:12	1.047
Subbasin-18	0.003	0.051	02Jan2013, 00:12	0.293
Subbasin-2	0.015	0.242	02Jan2013, 00:12	1.448
Subbasin-20	0.002	0.037	02Jan2013, 00:12	0.210
Subbasin-3	0.014	0.228	02Jan2013, 00:12	1.365
Subbasin-4	0.010	0.162	02Jan2013, 00:12	0.932
Subbasin-5	0.017	0.264	02Jan2013, 00:14	1.640
Subbasin-6	0.005	0.092	02Jan2013, 00:12	0.530
Subbasin-7	0.005	0.075	02Jan2013, 00:12	0.449
Subbasin-8	0.012	0.189	02Jan2013, 00:14	1.177
Subbasin-9	0.012	0.201	02Jan2013, 00:12	1.206

ANNEXURE C

HEC-HMS OUTPUT FOR THE POST-DEVELOPMENT CONDITION

HEC-HMS DIAGRAM



1:0,5 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	0.177	02Jan2013, 00:14	1.396
EXT2	0.214	0.145	02Jan2013, 00:14	1.146
EXT3	1.145	0.746	02Jan2013, 00:16	6.121
EXT4	0.298	0.194	02Jan2013, 00:16	1.593
EXT5	0.192	0.113	02Jan2013, 00:20	1.022
Junction-1	1.723	1.058	02Jan2013, 00:22	9.173
Reach-1	0.011	0.008	02Jan2013, 00:20	0.060
Reach-10	1.973	1.208	02Jan2013, 00:32	10.442
Reach-11	1.981	1.204	02Jan2013, 00:38	10.451
Reach-12	1.997	1.208	02Jan2013, 00:42	10.506
Reach-13	0.003	0.002	02Jan2013, 00:18	0.018
Reach-14	2.280	1.333	02Jan2013, 00:48	11.957
Reach-15	0.271	0.179	02Jan2013, 00:30	1.439
Reach-16	0.266	0.178	02Jan2013, 00:24	1.415
Reach-17	0.263	0.177	02Jan2013, 00:18	1.403
Reach-2	0.014	0.010	02Jan2013, 00:20	0.075
Reach-3	0.308	0.200	02Jan2013, 00:20	1.639
Reach-4	0.232	0.139	02Jan2013, 00:24	1.233
Reach-5	0.237	0.142	02Jan2013, 00:30	1.258
Reach-6	1.481	0.944	02Jan2013, 00:22	7.891
Reach-7	1.723	1.054	02Jan2013, 00:28	9.145
Reach-8	0.241	0.161	02Jan2013, 00:24	1.280
Reach-9	0.227	0.152	02Jan2013, 00:20	1.209
Sink-1	2.280	1.333	02Jan2013, 00:48	11.957
Subbasin-1	0.011	0.008	02Jan2013, 00:14	0.061
Subbasin-10	0.007	0.005	02Jan2013, 00:14	0.038
Subbasin-11	0.007	0.005	02Jan2013, 00:14	0.037
Subbasin-12	0.009	0.006	02Jan2013, 00:14	0.050
Subbasin-13	0.008	0.005	02Jan2013, 00:14	0.041
Subbasin-14	0.013	0.009	02Jan2013, 00:14	0.070
Subbasin-15	0.003	0.002	02Jan2013, 00:12	0.018
Subbasin-16	0.005	0.004	02Jan2013, 00:14	0.029
Subbasin-17	0.011	0.007	02Jan2013, 00:14	0.058
Subbasin-18	0.003	0.002	02Jan2013, 00:12	0.016
Subbasin-2	0.015	0.010	02Jan2013, 00:14	0.080
Subbasin-20	0.002	0.002	02Jan2013, 00:12	0.012
Subbasin-3	0.014	0.010	02Jan2013, 00:14	0.075
Subbasin-4	0.010	0.007	02Jan2013, 00:12	0.051
Subbasin-5	0.017	0.011	02Jan2013, 00:16	0.090
Subbasin-6	0.005	0.004	02Jan2013, 00:12	0.029
Subbasin-7	0.005	0.003	02Jan2013, 00:14	0.025
Subbasin-8	0.012	0.008	02Jan2013, 00:16	0.065
Subbasin-9	0.012	0.008	02Jan2013, 00:14	0.066

1:1 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	0.541	02Jan2013, 00:12	3.547
EXT2	0.214	0.444	02Jan2013, 00:12	2.911
EXT3	1.145	2.290	02Jan2013, 00:14	15.552
EXT4	0.298	0.596	02Jan2013, 00:14	4.048
EXT5	0.192	0.344	02Jan2013, 00:18	2.598
Junction-1	1.723	3.262	02Jan2013, 00:22	23.850
Reach-1	0.011	0.023	02Jan2013, 00:18	0.153
Reach-10	1.973	3.741	02Jan2013, 00:30	27.430
Reach-11	1.981	3.739	02Jan2013, 00:36	27.570
Reach-12	1.997	3.743	02Jan2013, 00:40	27.955
Reach-13	0.003	0.022	02Jan2013, 00:12	0.093
Reach-14	2.280	4.116	02Jan2013, 00:46	31.963
Reach-15	0.271	0.561	02Jan2013, 00:28	3.813
Reach-16	0.266	0.551	02Jan2013, 00:22	3.673
Reach-17	0.263	0.549	02Jan2013, 00:18	3.598
Reach-2	0.014	0.029	02Jan2013, 00:18	0.190
Reach-3	0.308	0.624	02Jan2013, 00:18	4.306
Reach-4	0.232	0.424	02Jan2013, 00:24	3.134
Reach-5	0.237	0.432	02Jan2013, 00:28	3.278
Reach-6	1.481	2.938	02Jan2013, 00:20	20.442
Reach-7	1.723	3.261	02Jan2013, 00:26	23.783
Reach-8	0.241	0.506	02Jan2013, 00:22	3.459
Reach-9	0.227	0.470	02Jan2013, 00:18	3.071
Sink-1	2.280	4.116	02Jan2013, 00:46	31.963
Subbasin-1	0.011	0.023	02Jan2013, 00:12	0.154
Subbasin-10	0.007	0.044	02Jan2013, 00:08	0.203
Subbasin-11	0.007	0.042	02Jan2013, 00:08	0.195
Subbasin-12	0.009	0.057	02Jan2013, 00:08	0.264
Subbasin-13	0.008	0.047	02Jan2013, 00:08	0.218
Subbasin-14	0.013	0.080	02Jan2013, 00:08	0.371
Subbasin-15	0.003	0.022	02Jan2013, 00:06	0.093
Subbasin-16	0.005	0.032	02Jan2013, 00:08	0.150
Subbasin-17	0.011	0.066	02Jan2013, 00:08	0.304
Subbasin-18	0.003	0.020	02Jan2013, 00:06	0.085
Subbasin-2	0.015	0.031	02Jan2013, 00:12	0.202
Subbasin-20	0.002	0.014	02Jan2013, 00:06	0.061
Subbasin-3	0.014	0.029	02Jan2013, 00:12	0.191
Subbasin-4	0.010	0.064	02Jan2013, 00:06	0.270
Subbasin-5	0.017	0.097	02Jan2013, 00:08	0.476
Subbasin-6	0.005	0.036	02Jan2013, 00:06	0.154
Subbasin-7	0.005	0.028	02Jan2013, 00:08	0.130
Subbasin-8	0.012	0.024	02Jan2013, 00:14	0.164
Subbasin-9	0.012	0.026	02Jan2013, 00:12	0.168

1:10 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	2.227	02Jan2013, 00:12	13.547
EXT2	0.214	1.828	02Jan2013, 00:12	11.119
EXT3	1.145	9.438	02Jan2013, 00:14	59.405
EXT4	0.298	2.456	02Jan2013, 00:14	15.462
EXT5	0.192	1.428	02Jan2013, 00:18	9.929
Junction-1	1.723	13.383	02Jan2013, 00:20	90.162
Reach-1	0.011	0.097	02Jan2013, 00:18	0.586
Reach-10	1.973	15.305	02Jan2013, 00:30	103.312
Reach-11	1.981	15.268	02Jan2013, 00:36	103.695
Reach-12	1.997	15.283	02Jan2013, 00:40	104.772
Reach-13	0.003	0.060	02Jan2013, 00:12	0.264
Reach-14	2.280	16.783	02Jan2013, 00:46	119.600
Reach-15	0.271	2.277	02Jan2013, 00:28	14.294
Reach-16	0.266	2.250	02Jan2013, 00:22	13.899
Reach-17	0.263	2.245	02Jan2013, 00:18	13.689
Reach-2	0.014	0.120	02Jan2013, 00:18	0.727
Reach-3	0.308	2.537	02Jan2013, 00:18	16.193
Reach-4	0.232	1.757	02Jan2013, 00:24	11.982
Reach-5	0.237	1.783	02Jan2013, 00:28	12.390
Reach-6	1.481	12.000	02Jan2013, 00:20	77.403
Reach-7	1.723	13.368	02Jan2013, 00:26	89.959
Reach-8	0.241	2.037	02Jan2013, 00:22	12.836
Reach-9	0.227	1.929	02Jan2013, 00:18	11.736
Sink-1	2.280	16.783	02Jan2013, 00:46	119.600
Subbasin-1	0.011	0.097	02Jan2013, 00:12	0.587
Subbasin-10	0.007	0.121	02Jan2013, 00:08	0.576
Subbasin-11	0.007	0.116	02Jan2013, 00:08	0.553
Subbasin-12	0.009	0.157	02Jan2013, 00:08	0.749
Subbasin-13	0.008	0.130	02Jan2013, 00:08	0.618
Subbasin-14	0.013	0.221	02Jan2013, 00:08	1.052
Subbasin-15	0.003	0.060	02Jan2013, 00:06	0.264
Subbasin-16	0.005	0.090	02Jan2013, 00:08	0.427
Subbasin-17	0.011	0.181	02Jan2013, 00:08	0.862
Subbasin-18	0.003	0.055	02Jan2013, 00:06	0.241
Subbasin-2	0.015	0.127	02Jan2013, 00:12	0.773
Subbasin-20	0.002	0.039	02Jan2013, 00:06	0.173
Subbasin-3	0.014	0.120	02Jan2013, 00:12	0.728
Subbasin-4	0.010	0.174	02Jan2013, 00:06	0.767
Subbasin-5	0.017	0.270	02Jan2013, 00:08	1.350
Subbasin-6	0.005	0.099	02Jan2013, 00:06	0.436
Subbasin-7	0.005	0.078	02Jan2013, 00:08	0.369
Subbasin-8	0.012	0.100	02Jan2013, 00:14	0.628
Subbasin-9	0.012	0.106	02Jan2013, 00:12	0.643

1:50 YR

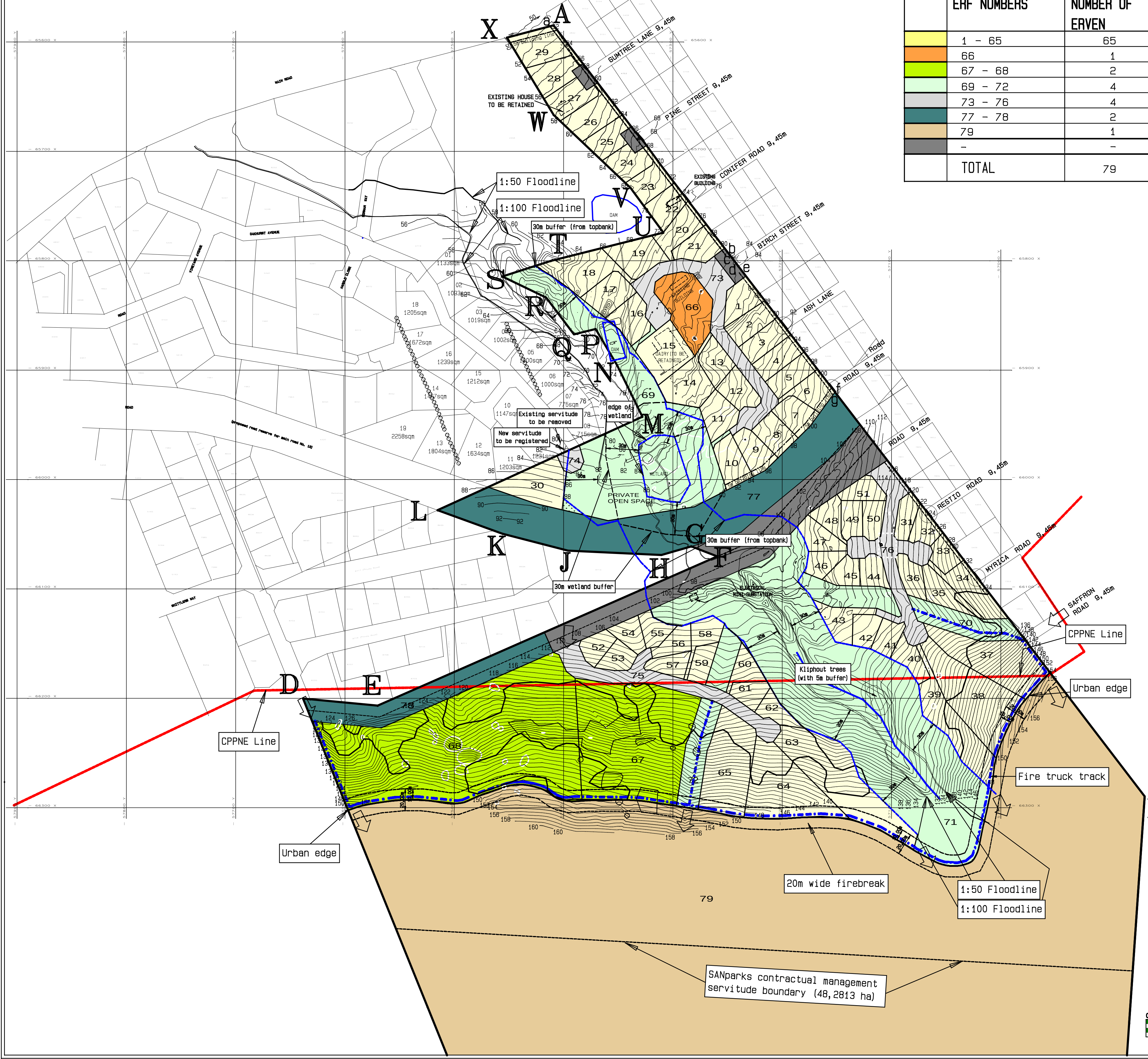
Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	3.588	02Jan2013, 00:12	21.584
EXT2	0.214	2.945	02Jan2013, 00:12	17.716
EXT3	1.145	15.178	02Jan2013, 00:14	94.655
EXT4	0.298	3.950	02Jan2013, 00:14	24.637
EXT5	0.192	2.294	02Jan2013, 00:18	15.823
Junction-1	1.723	21.482	02Jan2013, 00:20	143.309
Reach-1	0.011	0.156	02Jan2013, 00:18	0.933
Reach-10	1.973	24.534	02Jan2013, 00:30	164.072
Reach-11	1.981	24.440	02Jan2013, 00:36	164.630
Reach-12	1.997	24.481	02Jan2013, 00:40	166.202
Reach-13	0.003	0.087	02Jan2013, 00:12	0.385
Reach-14	2.280	26.839	02Jan2013, 00:46	189.654
Reach-15	0.271	3.648	02Jan2013, 00:28	22.675
Reach-16	0.266	3.615	02Jan2013, 00:22	22.098
Reach-17	0.263	3.606	02Jan2013, 00:18	21.792
Reach-2	0.014	0.193	02Jan2013, 00:18	1.158
Reach-3	0.308	4.069	02Jan2013, 00:18	25.704
Reach-4	0.232	2.822	02Jan2013, 00:24	19.098
Reach-5	0.237	2.863	02Jan2013, 00:28	19.693
Reach-6	1.481	19.244	02Jan2013, 00:20	123.076
Reach-7	1.723	21.431	02Jan2013, 00:26	143.012
Reach-8	0.241	3.258	02Jan2013, 00:22	20.309
Reach-9	0.227	3.102	02Jan2013, 00:18	18.703
Sink-1	2.280	26.839	02Jan2013, 00:46	189.654
Subbasin-1	0.011	0.156	02Jan2013, 00:12	0.936
Subbasin-10	0.007	0.175	02Jan2013, 00:08	0.841
Subbasin-11	0.007	0.168	02Jan2013, 00:08	0.807
Subbasin-12	0.009	0.228	02Jan2013, 00:08	1.094
Subbasin-13	0.008	0.188	02Jan2013, 00:08	0.903
Subbasin-14	0.013	0.320	02Jan2013, 00:08	1.536
Subbasin-15	0.003	0.087	02Jan2013, 00:06	0.386
Subbasin-16	0.005	0.130	02Jan2013, 00:08	0.623
Subbasin-17	0.011	0.262	02Jan2013, 00:08	1.259
Subbasin-18	0.003	0.079	02Jan2013, 00:06	0.352
Subbasin-2	0.015	0.205	02Jan2013, 00:12	1.231
Subbasin-20	0.002	0.057	02Jan2013, 00:06	0.253
Subbasin-3	0.014	0.193	02Jan2013, 00:12	1.161
Subbasin-4	0.010	0.252	02Jan2013, 00:06	1.120
Subbasin-5	0.017	0.392	02Jan2013, 00:08	1.971
Subbasin-6	0.005	0.143	02Jan2013, 00:06	0.637
Subbasin-7	0.005	0.112	02Jan2013, 00:08	0.539
Subbasin-8	0.012	0.160	02Jan2013, 00:14	1.000
Subbasin-9	0.012	0.170	02Jan2013, 00:12	1.025

1:100 YR

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
EXT1	0.261	4.236	02Jan2013, 00:12	25.393
EXT2	0.214	3.477	02Jan2013, 00:12	20.843
EXT3	1.145	17.911	02Jan2013, 00:14	111.359
EXT4	0.298	4.662	02Jan2013, 00:14	28.985
EXT5	0.192	2.707	02Jan2013, 00:18	18.617
Junction-1	1.723	25.338	02Jan2013, 00:20	168.474
Reach-1	0.011	0.184	02Jan2013, 00:18	1.098
Reach-10	1.973	28.927	02Jan2013, 00:30	192.836
Reach-11	1.981	28.804	02Jan2013, 00:36	193.474
Reach-12	1.997	28.858	02Jan2013, 00:40	195.271
Reach-13	0.003	0.099	02Jan2013, 00:12	0.441
Reach-14	2.280	31.623	02Jan2013, 00:46	222.801
Reach-15	0.271	4.300	02Jan2013, 00:28	26.640
Reach-16	0.266	4.266	02Jan2013, 00:22	25.981
Reach-17	0.263	4.254	02Jan2013, 00:18	25.630
Reach-2	0.014	0.228	02Jan2013, 00:18	1.362
Reach-3	0.308	4.798	02Jan2013, 00:18	30.205
Reach-4	0.232	3.329	02Jan2013, 00:24	22.471
Reach-5	0.237	3.377	02Jan2013, 00:28	23.152
Reach-6	1.481	22.692	02Jan2013, 00:20	144.705
Reach-7	1.723	25.268	02Jan2013, 00:26	168.134
Reach-8	0.241	3.839	02Jan2013, 00:22	23.842
Reach-9	0.227	3.661	02Jan2013, 00:18	22.004
Sink-1	2.280	31.623	02Jan2013, 00:46	222.801
Subbasin-1	0.011	0.184	02Jan2013, 00:12	1.101
Subbasin-10	0.007	0.200	02Jan2013, 00:08	0.962
Subbasin-11	0.007	0.192	02Jan2013, 00:08	0.923
Subbasin-12	0.009	0.260	02Jan2013, 00:08	1.251
Subbasin-13	0.008	0.215	02Jan2013, 00:08	1.033
Subbasin-14	0.013	0.365	02Jan2013, 00:08	1.757
Subbasin-15	0.003	0.099	02Jan2013, 00:06	0.442
Subbasin-16	0.005	0.148	02Jan2013, 00:08	0.713
Subbasin-17	0.011	0.299	02Jan2013, 00:08	1.440
Subbasin-18	0.003	0.091	02Jan2013, 00:06	0.403
Subbasin-2	0.015	0.242	02Jan2013, 00:12	1.448
Subbasin-20	0.002	0.065	02Jan2013, 00:06	0.289
Subbasin-3	0.014	0.228	02Jan2013, 00:12	1.365
Subbasin-4	0.010	0.288	02Jan2013, 00:06	1.281
Subbasin-5	0.017	0.447	02Jan2013, 00:08	2.255
Subbasin-6	0.005	0.164	02Jan2013, 00:06	0.728
Subbasin-7	0.005	0.128	02Jan2013, 00:08	0.617
Subbasin-8	0.012	0.189	02Jan2013, 00:14	1.177
Subbasin-9	0.012	0.201	02Jan2013, 00:12	1.206

SUBDIVISION SKETCH-PLAN

ALTERNATIVE 4



LAND-USE TABLE

	ERF NUMBERS	NUMBER OF ERVEN	AREA (ha)	AREA (%)	ZONING
(yellow)	1 - 65	65	7,6422	9,8	SINGLE RESIDENTIAL
(orange)	66	1	0,2458	0,3	SPECIAL RESIDENTIAL
(lime green)	67 - 68	2	3,2031	4,1	RURAL
(light green)	69 - 72	4	5,0967	6,5	PRIVATE OPEN SPACE
(light grey)	73 - 76	4	1,1533	1,5	PRIVATE ROAD
(dark teal)	77 - 78	2	1,8371	2,4	UNDETERMINED
(tan)	79	1	57,9547	74,1	RURAL
(dark grey)	-	-	1,0187	1,3	PUBLIC ROAD
	TOTAL	79	78,1516	100.0	

FLOOD-LINE:

I HEREWITH CERTIFY THAT THE PROPOSED SUBDIVISION IS AFFECTED BY THE 1:100 YEAR FLOOD LINE IN TERMS OF THE PROVISIONS OF SECTION 144 OF THE NATIONAL WATER ACT, 1998 (ACT 36 OF 1998)

---------------------- PR. ENG.

-------------- DATE

GENERAL NOTES:

1. Approximate areas and measurements shown only, subject to final survey
2. Subdivision Area boundary: ABCDEFGHJKLMNPQ RSTUVWX
3. Title deed number: T27941/1982
4. Minimum single residential erf size: 0,0654 ha
5. Maximum single residential erf size: 0,4547 ha
6. Minimum street gradient: 0,0%
7. Maximum street gradient: 13,3%
8. Total length of private roads: +- 0,928 km

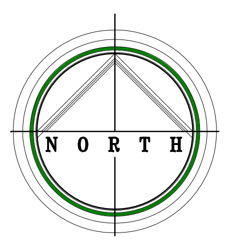
Access for emergency services and vehicles. (Conceptual)

Fire truck track

No access permitted to development

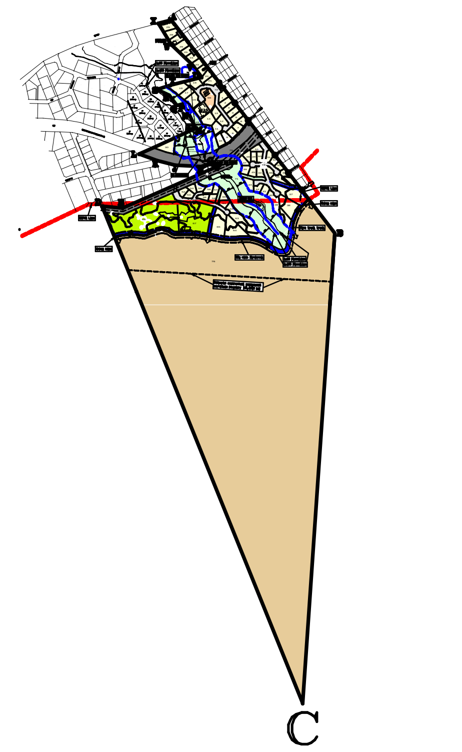
GUIDELINE COVERAGE PER ERF-SIZE CATEGORY:

Range of single residential erven (m^2)	COVERAGE Minimum	COVERAGE Maximum
650 - 800 m^2	210 m^2	35% of erf
801 - 1000 m^2	230 m^2	32% of erf
1001 - 1200 m^2	250 m^2	32%² of erf
1201 - 1500 m^2	280 m^2	28% of erf
1501 - 2000 m^2	300 m^2	25% of erf
2001 m^2 and larger	350 m^2	Subject to visual appearance and discretion of controlling architect and planning committee



PROJECT:

PROPOSED SUBDIVISION OF CONSOLIDATED ERF A/8343 AND R/2224, HOUT BAY



CONTROLLING AUTHORITY:	APPLICANT:
CITY OF CAPE TOWN METROPOLITAN MUNICIPALITY PRIVATE BAG X 5 PLUMSTEAD 7801	MESDAMES B I SCHER AND M DERMAN C/O PO BOX 26216 HOUT BAY 7872

J PAUL VAN WYK

URBAN ECONOMISTS & PLANNERS CC

POSBUS 11522
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HATFIELD 0028

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CELL : (082) 893-7370

DRAWN			FIGURE.
OLA/CVW/DdP		OLA	3
SCALE	DATE	CAD NO.	
1:2000 (A2)	2014-07-23	2224-08divan22	
DESIGN	CONTOUR INT.	PLAN NUMBER	
J.P. van Wyk	1 metre	E R/2224 HBAY SUBDIV/06	

LAND-USE TABLE

ERF NUMBERS	NUMBER OF ERVEN	AREA (ha)	AREA (%)	ZONING
1 - 65	65	7,6422	9,8	SINGLE RESIDENTIAL
66	1	0,2458	0,3	SPECIAL RESIDENTIAL
67 - 68	2	3,2031	4,1	RURAL
69 - 72	4	5,0967	6,5	PRIVATE OPEN SPACE
73 - 76	4	1,1533	1,5	PRIVATE ROAD
77 - 78	2	1,8371	2,4	UNDETERMINED
79	1	57,9547	74,1	RURAL
-	-	1,0187	1,3	PUBLIC ROAD
TOTAL	79	78,1516	100.0	

LEGEND

65 (green circle)	ERVEN WITH ON-SITE BIO-RETENTION FACILITIES
green arrow	COLLECTOR CHANNEL
EDC 01	ENHANCED DRY SWALE
orange band	CATCHMENT BOUNDRY
blue arrow	EXTERNAL CATCHMENT INFLOW
red line	1: 100 FLOOD LINE
blue line	1: 50 FLOOD LINE
blue dashed line	NATURAL WATER COURSE

REVISION:

No.	DATE	DESCRIPTION

NOTES:

SPECIFICATIONS:

PROJECT:

PROPOSED SUBDIVISION OF CONSOLIDATED ERF A/8343 AND R/2224, HOUT BAY

DRAWING TITLE

STORMWATER MANAGEMENT PLAN

CLIENT

MESDAMES B.I. SCHER AND M.DERMAN
C/O P.O BOX 26216
HOUTBAY
7872

Graeme McGill consulting
PO Box 332
Durbanville 7551
Tel: 021 975 3255
Fax: 086 517 6574
enquiries@mcgillconsulting.co.za

DRAWN BY	DESIGNED BY
E.O	GA McGILL Pr Eng No. 780269
DATE	01- 09 -2014
SCALE	1:1500
DRAWING NO	MC145-C400
REVISION	A

global

From: Graeme McGill Consulting <graeme@mcgillconsulting.co.za>
Sent: 14 May 2015 04:34 PM
To: Colleen McCreadie
Cc: Wasief Casper
Subject: Re: FW: FW: City queries on river buffer, Erf 2224
Attachments: COMMENT ON BUFFERS.jpg

Hi Colleen
I understand the small waterline that Toni is referring to is the one which passes across erf 67, road 75 and erf 54.
It is proposed to manage the stormwater by doing the following:

- The sheet flow from the slope above erf 67 will be collected in a cutoff channel along the upslope boundary of erf 67 and conveyed to the stream between erf 65 & erf 67.
- The road outlined in red will be cut with a crossfall against the slope and provided with a vertical alignment which has a grade which falls all the way down to the main road (dark green shading)
- The runoff from erf 67 and the road 75 will be conveyed in a channel located on the lower side of the crossfall (dashed blue line). This channel will continue to the main road and then follow the main road to the main watercourse, as shown.
- The small amount of runoff from the stub road can be conveyed overland across erf 54.

I hope that suffices.
Regards

--
Graeme McGill PrEng PrCPM

Graeme McGill Consulting

PO Box 332, Durbanville 7551
The Crest Estate Office Park, cnr Brackenfell Blvd & Goedemoed Rd, Durbanville 7550
GPS coordinates: 33°48'57.35"S 18°40'26.19"E
Cell +27 82 550 9108 Fax +27 86 517 6574

On 2015/05/14 08:47, Colleen McCreadie wrote:

> Dear Graeme
>
> Please could you revert on this as soon as possible? In the meantime, I will ask for more time from the City before they formally submit their comments.
>
> Thank you
>
> **From:** Graeme McGill Consulting [mailto:graeme@mcgillconsulting.co.za]
> **Sent:** 08 May 2015 03:19 PM
> **To:** Colleen McCreadie
> **Subject:** Re: FW: City queries on river buffer, Erf 2224
>
> Hi Colleen
>
> I'll study this & get back to you on Monday.

Regards

--

Graeme McGill PrEng PrCPM

Graeme McGill Consulting

PO Box 332, Durbanville 7551
The Crest Estate Office Park, cnr Brackenfell Blvd & Goedemoed Rd, Durbanville 7550
GPS coordinates: 33°48'57.35"S 18°40'26.19"E
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On 2015/05/08 08:39, Colleen McCreadie wrote:

Hi Graeme

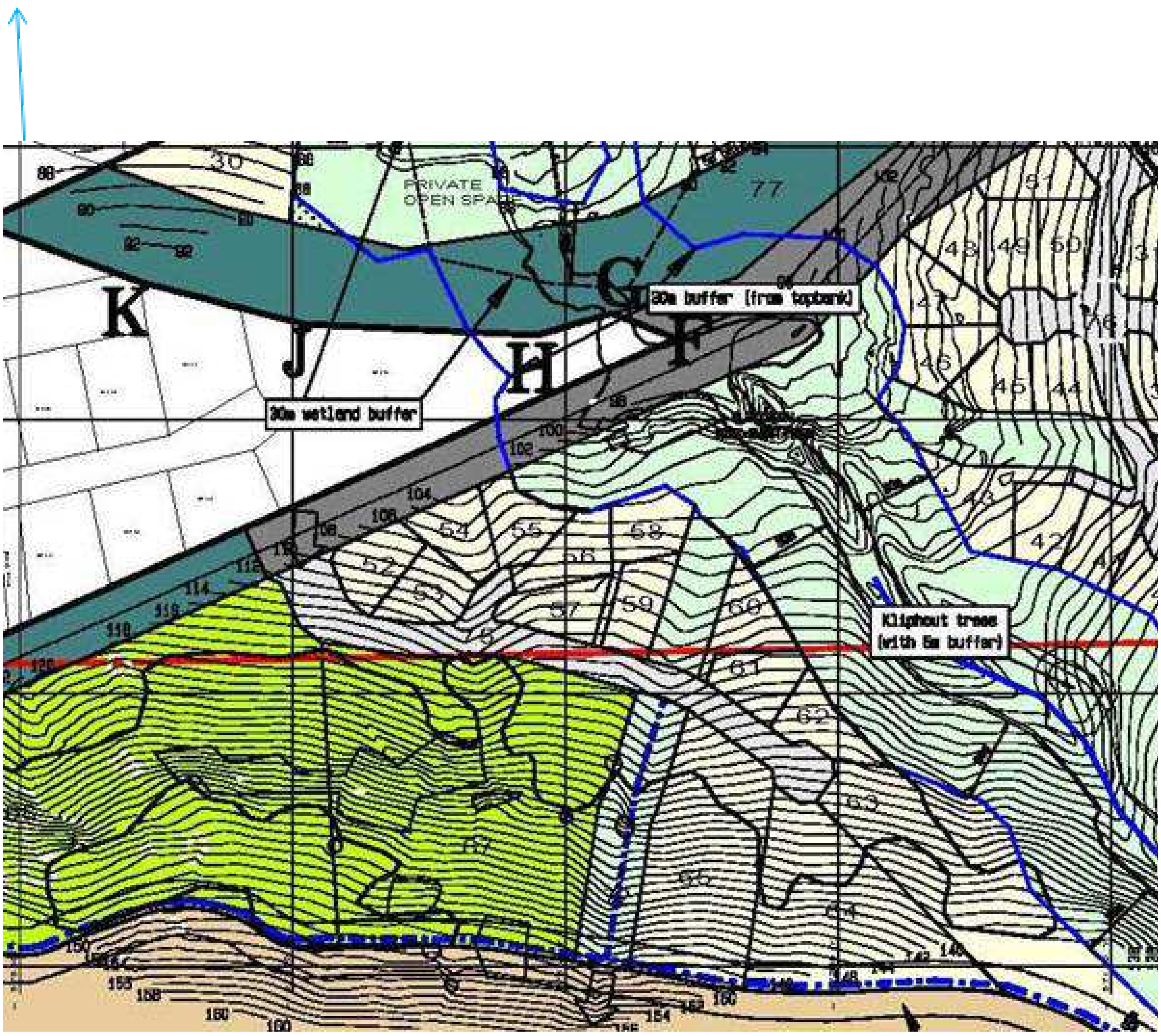
Please can you advise on the information supplied by the freshwater specialist, highlighted below? We don't want to leave this open-ended when we send to the City – we are in discussions with them on various aspects of the project before they comment formally on our final report.

Thank you

From: A Belcher [mailto:toni.b@iburst.co.za]
Sent: 07 May 2015 04:06 PM
To: Colleen McCreadie
Subject: City queries on river buffer, Erf 2224

Hi Colleen
Clarification on my recommendations re the buffers:
For the Bokkemanskloof River as a larger watercourse, I stipulated a river ***buffer*** of 30m which implies 30m as measured from top of bank for either side of the river. For the small tributaries, I stipulated a 20m ***corridor*** – usually with smaller watercourses the top of bank is poorly defined thus one would measure from the centre of the stream. A corridor implies incorporating the buffers on both sides of the stream thus 10m buffers for either side of the centre of the stream to provide a total corridor width of 20m. These streams are largely drainage lines that primarily act as conduits for water draining the mountain slopes and have little associated aquatic ecosystems. Their most important functionality being their link to the larger Bokkemanskloof River and in so doing provide additional opportunities for the movement of biota via the 20m wide corridor.

With regards to the third, smaller tributary, the feature is not so significant that it warrants incorporation in the layout plan with river corridors – it is only slightly visible on the surveyed contours for the site (see below) and of very low ecological significance. One would however need to take cognisance that there is a drainage line there that will carry runoff from the hill slope and will need to be accommodated in the stormwater management plan for the site.



Kind regards
Toni

Antonia Belcher ***Pr.Sci.Nat***
Aquatic Scientist

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Fax: +27 (0)86 620 1812
www.bluescience.co.za

From: Colleen McCreadie [mailto:colleen@environmentalconsultants.co.za]
Sent: 06 May 2015 08:30 AM
To: A Belcher; airtaxi@mweb.co.za
Subject: City queries on river buffer, Erf 2224

Dear Toni, Ola and Paul

We have had a query from the City with respect to the width of the buffer areas around the tributaries.

Toni, your addendum that we discussed and worked off before the final changes to the layout plan in May 2014, states “corridor”:

“In the alteration of the layout plan, however the open space provided for in which the tributaries of the Bokkemanskloof River were located appears to have been reduced to a 10m wide strip. It is recommended that this corridor should be at least 20 to 30m wide”.

And your comment on the finalised development layout from June 2014 states:

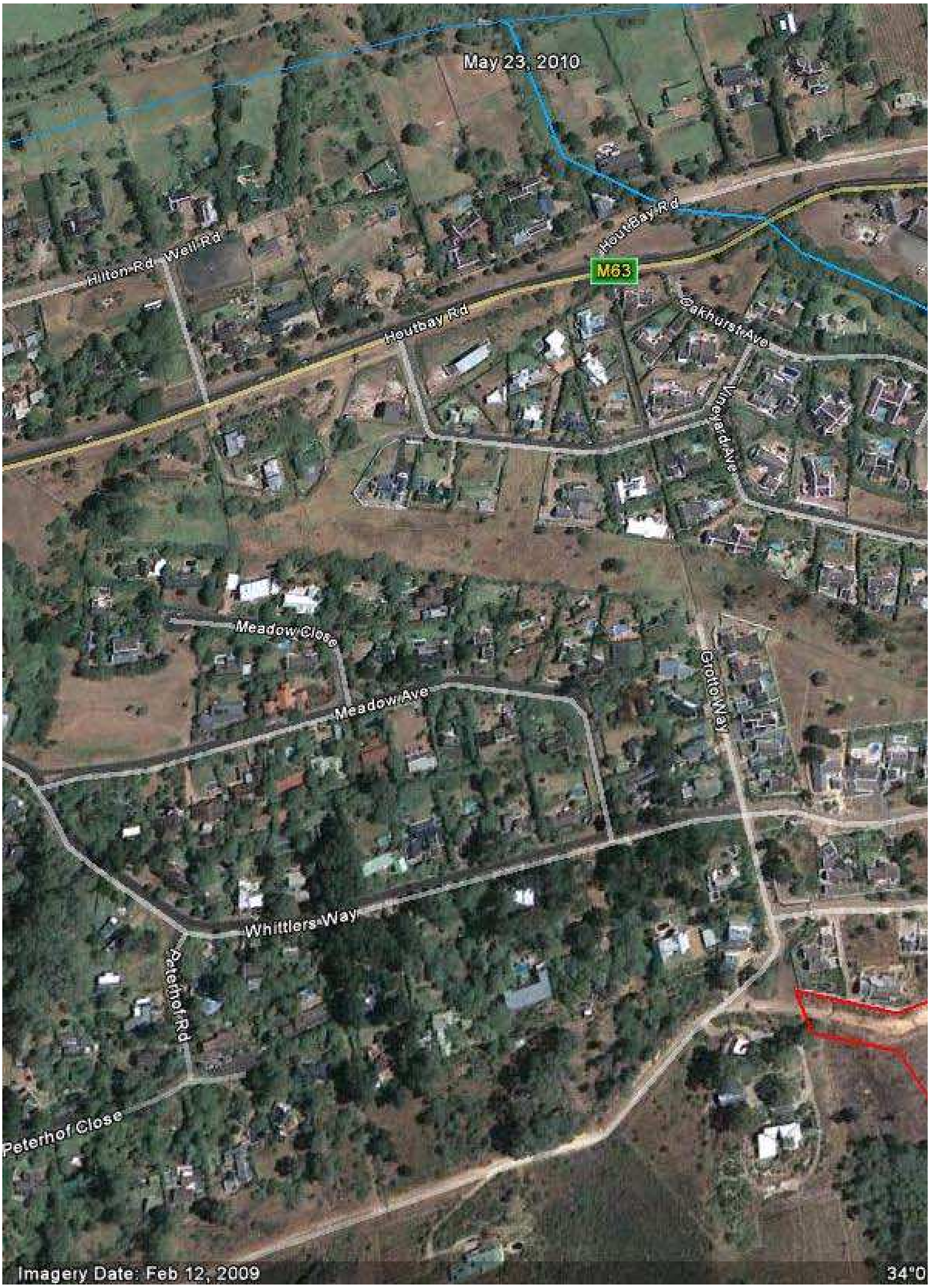
“The final layout plan for the development now allows for a 30m buffer along the Bokkemanskloof River and its associated wetland area and 20m wide <u>corridors</u> for the tributaries of the river. Both the 1 in 50 year and 1 in 100 year flood lines lie within these buffer areas. These buffers are deemed to be sufficient for the protection of the freshwater features within the site. The other recommendations included in the freshwater report for the project still apply”

My understanding is that the width of a buffer or corridor is measured from the top of the river bank, i.e.: “20m corridor” is 20m from top of each bank, i.e. some 40m plus the width of the river channel below the “top of banks”.

Please can you advise further?

And Paul and Ola, with the finalised layout, what width has been allowed for along the tributaries, please?

Also, the City has noted that the figure below (from the 2010 freshwater study) identifies 3 tributaries, but there appears to be only one corridor of open space lying westwards off the main river corridor in the final layout plan. Toni, please can you elaborate on this – why the development layout is considered to be adequate with just the two open space corridors – one lying westwards and one lying eastwards off the main river corridor?



Thank you

Kind regards

sillitò
ENVIRONMENTAL CONSULTING

"Environmental Solutions for a Changing World"

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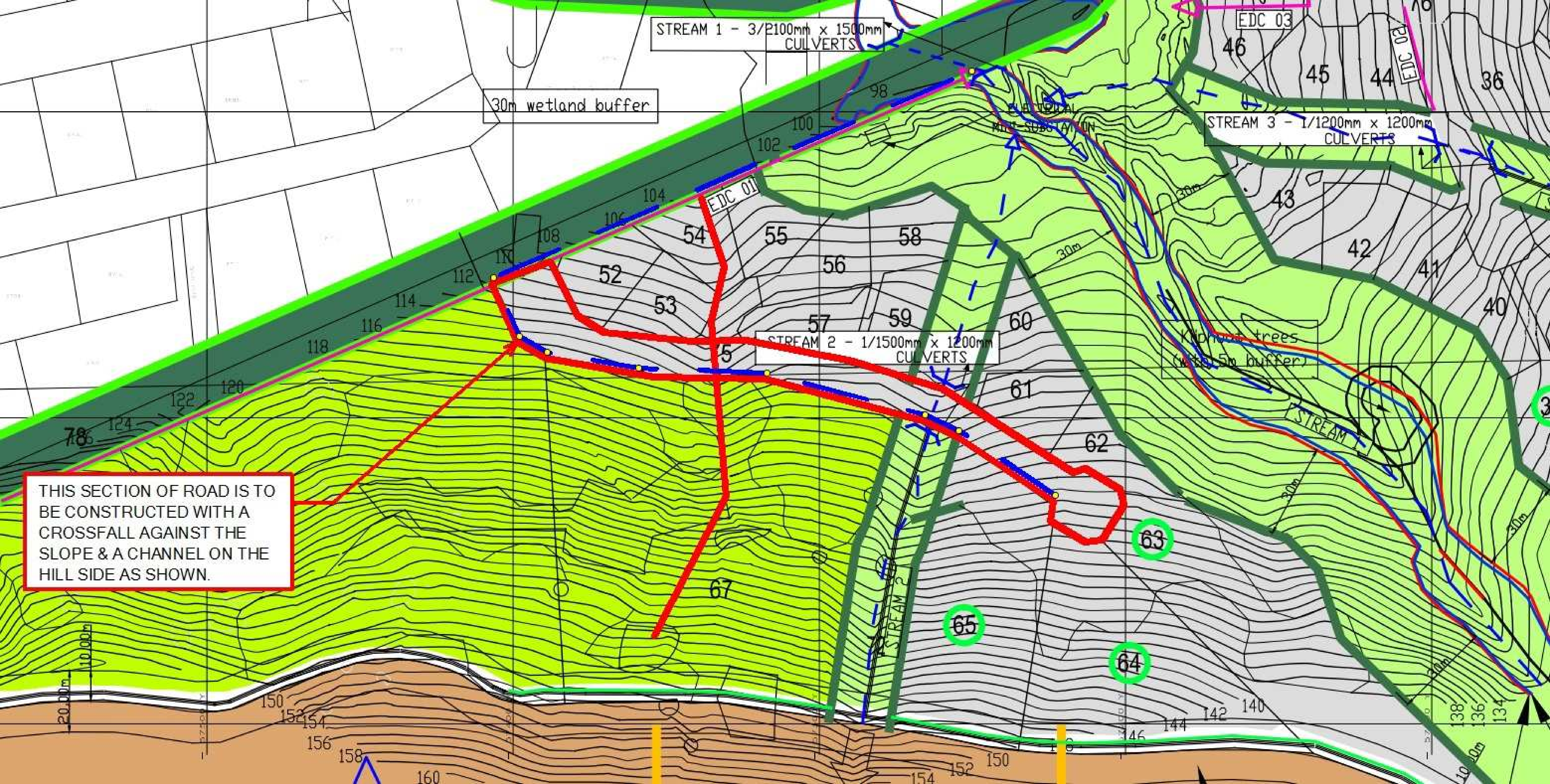
STREAM 1 - 3/2100mm x 1500mm CULVERTS
30m wetland buffer
EDC 03
EDC 02
EDC 01
STREAM 3 - 1/1200mm x 1200mm CULVERTS
ELECTRICAL MINI-SUBSTATION
STREAM 2 - 1/1500mm x 1200mm CULVERTS
Kiphout trees (with 5m buffer)
STREAM
STREAM 2
THIS SECTION OF ROAD IS TO BE CONSTRUCTED WITH A CROSSFALL AGAINST THE SLOPE & A CHANNEL ON THE HILL SIDE AS SHOWN.
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