Flat Bush Catchment Management Implementation Plan

Version A6

June 2004

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Catchment Management
Implementation Plan

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Prepared for
Manukau City Council

By
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Revision History

Revision Nº	Prepared By	Description	Date
A	Graham Levy	Draft	29 August 2002
A1	Graham Levy	Minor updates to reflect G Levy evidence and commissioners comments	21 October 2002
A2	MCC	Incorporation of outcomes of Environment Court mediation	3 June 2003
A3	Beca Carter Hollings & Ferner Ltd	Finalise document	23 September 2003
A4	Beca Carter Hollings & Ferner Ltd	Minor changes to incorporate findings of flood plain investigations	19 March 2004
A5	Yasenko Krpo	Amendements as per Burton Consultants e mail 27 April 2004 and WAPCO fax 12 May 2004	25 May 2004
A6	Yasenko Krpo	Amendements as per Burton Consultants e mail 4 June 2004 and ARC e mail 14 June and WAPCO e mail 15 June 2004	16 June 2004

Upper Catchment	Areas in the higher elevations to the east of the catchment covered by the Flatbush Countryside Transition Zone.
Middle Catchment	Areas of generally rolling hills covered primarily by medium density residential zoning.
Lower Catchment	Areas of higher intensity development in the lower parts of the catchment including the town centre and adjacent areas.
Principal Streams	Those streams which link the headwater streams to the sea.
Stormwater Management Area	Means land which is expected to be inundated or affected as a result of a 100 year flood, or by any other level of flood identified as part of a Comprehensive Discharge Permit or other approved discharge permit.
Flood Risk Areas	Those areas which presently are, or may in the future be, subject to flooding in the 100 year flood event.
ARC TP10	Includes both the existing document and any subsequent revisions or equivalent documents which supercede the existing document, but subject to reference to specific revisions where these are identified in the Discharge Consent or subsequent Consent reviews.

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Appendices

1 Purpose and Scope

Introduction

Monitoring of the effects of urban stormwater discharges in the Auckland Region has shown that they can adversely affect flooding, water quality, stream condition and the quality of the marine receiving environment.

Experience has shown that it is much more efficient to integrate planning for communities and the natural environment at the implementation of urbanisation than by retrofitting to existing urban areas. This integrated approach has been a driver for planning of development in the Flat Bush area, and the stormwater management component has been part of this integrated planning. As such, it complies with the principles of the RMA.

Purpose

The purpose of the Flat Bush Catchment Management Implementation Plan (FBCMIP) is to set out the proposed approach to management of stormwater in the Flat Bush Catchment (CID No. 644). At present this area is predominantly rural, but has been identified for predominantly future urban growth. The approach adopted to stormwater management will be one important element in determining the future character of the area, and the effects of development on areas downstream.

This document draws on the findings of the Development East Tamaki Comprehensive Catchment Management Plan (DET CCMP), prepared for Manukau City Council in May 2001. That Plan outlines the broad background to stormwater management, and contains technical details and analysis with reference to which the FBCMIP has been developed. The DET CCMP formed the basis of an application to the Auckland Regional Council (ARC) for a comprehensive stormwater discharge consent for the Flat Bush catchment but does not form part of the consent.

The FBCMIP is intended to apply specifically to the future catchment land use, and to provide guidance both through the development phase and into to a fully developed phase of the catchment. It is intended that it be used by:

- Auckland Regional Council (ARC) as the basis for consideration and granting of a comprehensive discharge consent for the catchment.
- Manukau City Council as a guide to granting of consents for development in the area;
- Manukau City Council as a guide to future operation of the stormwater management system in the catchment;
- Land owners and developers as a guide for planning and executing development.

Scope

The FBCMIP covers the following scope:

- An overview description of the catchment and its hydrology, in the context of the wider Otara Stream catchment group (CID Nos. 637, 638, 639, 640, 641, 642, 643, 644) and the Otara Lake receiving environment;
- Reference to other documents which also have an influence on how the area will be developed, and in the context of which stormwater management must therefore be considered;
- The objectives for stormwater management in the catchment, and how these will be achieved;
- The proposed methods for implementation of stormwater management in the catchment;
- A brief outline of how to use this FBCMIP.

It is intended that this FBCMIP, along with the documents outlined in Section 3, will provide sufficient guidance for design of stormwater management in this catchment. Specific engineering studies may need to be carried out for individual development areas and subcatchments, but should not need to look at a wider area so long as the design complies with this FBCMIP.

2 Catchment Description

The Flat Bush catchment covers approximately 1735 ha of land extending from Te Irirangi Drive in the west up to a prominent ridge in the east, and from Redoubt Road in the south to Browns Lane in the north. The general area is illustrated on Map 9A attached. Downstream of the study catchment the stream joins the southern tributary of Otara Creek, and discharges to Otara Lake and thence to a tidal reach of the Tamaki River. Much of the study catchment area is currently in rural use, but downstream is mostly urban, as is the southern tributary.

The topography is flat to gently rolling in the lower reaches, becoming increasingly steep in the upper reaches. There is land instability in the steeper areas to the east in particular. The various small tributary streams through the area are generally modified by adjacent farming activities, but nevertheless form important habitat for native fish, and provide migratory access to the higher quality and ecologically important upper reaches.

Indicative hydrological characteristics under the present land use are given below. These are at the Hills Road flow recorder (8 year record), 2.5 km downstream from the area considered by this FBCMIP and with about 10% more catchment area.

Mean flow	0.3 m^3/s
10 year ARI 7 day duration low flow	5.7 L/s
2 year ARI flood peak flow	20 m^3/s
100 year ARI flood peak flow	67 m^3/s

Manukau City Council proposes that the District Plan be changed so that the catchment can be developed for predominantly urban use. This will result in increased runoff from the catchment, with the potential effects of increased stream erosion, increased flood risk both in the area itself and downstream, and increased sediment load to the stream and the receiving environment (especially during the development phase). There is also a risk of the stream environment being lost through either piping, or damage to the watercourse and riparian margins

In general, the Otara Creek downstream through the urban area is heavily modified, with limited capacity and very little flood plain. Therefore the Flat Bush development should not increase flood peak flows to downstream.

The receiving environment at Otara Lake and Tamaki River is depositional. Sediment and other contaminants generated in the Flat Bush area will predominantly settle in those environments, and the development should be designed to achieve the best practicable reduction in sediment and contaminant discharge.

3 Related Documents

While this document sets out the basis for management of stormwater in the Flat Bush Catchment, there are other related documents including studies, guidelines and statutory documents. These include, but are not necessarily limited to:

- Manukau District Plan, including Variation 13, which will become part of the Manukau District Plan once finalised;
- Manukau City Council Engineering Quality Standards and MANARC Standards;
- Manukau City Council Parks Strategy;
- Manukau City Council Monitoring Strategy;
- The Development East Tamaki Comprehensive Catchment Management Plan, which provides historical background information on the philosophy and approach to stormwater management, as well as providing an interface with the Variation 13 process;
- Relevant Auckland Regional Council guidelines, including the following:
  - TP10 Stormwater Treatment Devices Design Guideline Manual (current manual 1992, draft update 2002)
  - TP90 Erosion and Sediment Control Guidelines for Land Disturbing Activities
  - TP108 Guidelines for Stormwater Runoff Modelling in the Auckland Region
  - TP 124 Low Impact Design Manual for the Auckland Region
  - TP131 Fish Passage Guidelines for the Auckland Region
  - TP 148 Riparian Zone Management
- Proposed Regional Land, Air Water Plan, and other transitional regional rules.
- The Comprehensive catchment Stormwater Discharge consent for this catchment as attached

4 Stormwater Catchment Management Objectives

Manukau City Council's objective for the FBCMIP, in the context of the future development of the Flat Bush area, and the provisions of the associated Variation 13 to the Manukau District Plan, is:

> *To achieve an integrated approach to stormwater management, improving biodiversity and integration of recreational and amenity values.*

The approach adopted by Council that in part sets a range of key targets for the FBCMIP is:

> *To manage the stormwater budget in an integrated manner to minimise risk of flooding and enhance the quality of water through innovative and effective engineering techniques which support a high quality environment.*

The FBCMIP operates in the context of Variation 13 to the Manukau District Plan, and the objectives of that Variation. The FBCMIP therefore includes a number of measures such as those to protect the natural character of the streams from the effects of development. It is essential in implementing stormwater management measures in the catchment that these wider objectives addressed in the District Plan are not compromised.

While the Manukau City Council will be the holder of the discharge consent and will have ultimate responsibility for implementing the FBCMIP, several different parties (including MCC, developers and landowners) will be responsible for different aspects of the implementation and of compliance with the consent, where their activities are governed by the consent. Defining the split of these responsibilities between the parties is not within the scope of the FBCMIP or the comprehensive catchment stormwater discharge consent, but is instead determined under separate statutory instruments, such as the District Plan and Variation 13.

The Council's objectives for stormwater management in the Flat Bush Catchment are set out in Table 4.1 below, along with measures proposed by Council to achieve those objectives.

Table 4.1

Stormwater management objectives and responses

Objectives and effects	*Management responses*
To manage the volume and peak flow rate and the passage of stormwater runoff to limit stream erosion.	■ Provide for revegetation of upper catchment areas in the Countryside Transition Zone, to improve infiltration of water to the ground and reduce flood peak flows from these areas in frequent storms. ■ Require stormwater disposal from impervious areas to the land in the Countryside Transition Zone, to improve infiltration of water to the ground and reduce flood peak flows from these areas in frequent storms except where that is inappropriate for slope stability or safety reasons. ■ Require the provision of extended detention to retain the runoff from 34.5mm of rain on any development area, and release it to the stream over a period of 24 hours. ■ Retain extensive existing flood plains and small main stream channels to reduce flow concentration and velocity in the main channel. ■ Provide for appropriate stream bank planting to reduce the risk of bank erosion. ■ Provide for appropriate flood plain planting to slow food plain flows without blocking flow paths or concentrating flows at any point.
To manage the peak flow rate of stormwater runoff to avoid increased flood risk within the catchment and in the areas downstream	■ Retain the extent of existing flood plains (shown on Map 10A) on protected streams (as shown on Map 9A), to assist in attenuating peak flows unless a satisfactory alternative means of managing flows is adopted. ■ Promote appropriate design solutions to minimise the inappropriate build-up of flood levels upstream where roads or services cross streams, or works are within flood plain areas, except where this is specifically required for stream management purposes. ■ Implement the catchment stormwater management system such that peak flows to lower Otara Creek (downstream of this catchment) in the 100 year ARI storm do not increase as a result of land development. ***continued overpage***

Table 4.1 continues

Objectives and effects	*Management responses*
	■ Require flood attenuation ponds to provide capacity to attenuate the flows from the 2, 10 and 100 year ARI storm events as identified in Appendix B of this FBCMIP. [Note – in order to avoid an increase in peak flood flow in lower Otara Creek, attenuation to about 80% of the pre-development peak flow is typically necessary.] ■ It is preferable that the flood plain areas identified in Variation 13 and Map 10A remain free of development. Filling will be acceptable in principle at the town centre, between nodes 70 to 30, between nodes 60 to 50, on ephemeral tributary gullies that may be piped or where outside stormwater management areasor where associated with permitted crossings. Any filling shall not result in the flood plain width being narrower than is noted in Maps 10A and 11A. ■ Both the primary (piped) and secondary (overland) stormwater systems servicing development areas shall be implemented so that flood risk is appropriately managed.
To manage the discharge of contaminants in stormwater runoff as far as practicable to avoid those contaminants reaching high value receiving environments	■ Provide for the treatment of discharges from developed areas by removal of contaminants in accordance with regional standards. ■ Have regard to source control at high risk sites by applying the BPO for on-site management. ■ Implement appropriate methods for erosion and sediment control for all works within the catchment considering both on-site and subcatchment-wide measures. ■ Erosion and sediment control measures to be in place throughout all development stages. ■ Provide for appropriate monitoring by MCC downstream to detect any increased effects from development.
To maintain stormwater in the catchment to assist in retaining dry season stream flows	■ Where appropriate and practicable, encourage the use of techniques which increase the discharge of water to ground; for example, low impact design. ■ Provide for revegetation of upper catchment areas in the Countryside Transition Zone, to improve infiltration of water to the ground. ■ Require stormwater disposal from impervious areas to the land in the Countryside Transition Zone, to improve infiltration of water to the ground except where that is inappropriate for slope stability or safety reasons. ***continues overpage***

Table 4.1 continues

Objectives and effects	*Management responses*
To provide for appropriate development and ongoing operation and maintenance of stormwater management assets.	■ Provide for secured access for maintenance and sediment removal from all stormwater quality devices. ■ Regular monitoring of the accumulation of sediment in the devices, and development of an appropriate maintenance programme for the devices in the catchment. ■ Provision of access for maintenance into and along the stream corridors. ■ Monitoring of the stream channels for vegetation blockage, sedimentation or erosion. Development of an appropriate maintenance plan for the streams and floodplains.
Maintain through passage for fish such as banded kokopu and shortfin eels from the sea, through lowland streams to headwater streams where streams have been identified as important for fish passage.	■ Maintain appropriate main-stem lowland streams as natural streams, including stream habitat for native fish ■ Natural stream character is to be retained for protected watercourses that connect headwater streams to the sea (as shown in Map 9A). ■ Provide for passage of banded kokopu and shortfin eels through the full length of protected streams as shown in Map 9A.
To protect waterways that have been identified as having a high actual habitat value and enhance waterways having a high potential habitat value	■ Provide appropriate riparian planting on protected waterways for the purpose of bank protection, stream cover, water temperature reduction and / or generation of food for fish. ■ Implement stormwater management and site development so that the natural stream flow regime is maintained as far as practicable. ■ Provide appropriate stream maintenance and weed management of such waterways to protect stream habitat and avoid siltation of the stream bed and reduction of capacity, while still retaining features that enhance habitat and provide habitat variety. ■ Any stream enhancement that does occur shall provide a mix of flow conditions including pools and runs.
To provide guidelines for Council and developers to assist in implementing this FBCMIP	■ Provide direct guidance specific to this catchment within this FBCMIP. ■ MCC to provide for ongoing improvements to its design guidelines and codes of practice. ■ MCC to develop new guidelines where appropriate for successful implementation (e.g. riparian and revegetation guidelines). ■ Making use of existing regional guidelines where applicable. ■ Setting up processes for regular review and update of the hydrological and hydraulic model of the catchment as development within the catchment proceeds.

5 Implementation Methods

The implementation methods detailed below expand on the responses outlined above. They address each specific aspect of implementation of stormwater management for the catchment.

5.1 Upper catchment stormwater runoff

General approach

In the steeper upper catchments covered by the Countryside Transition Zone stormwater management will consist of increased interception by revegetated hill slopes, and disposal to ground of stormwater from impervious areas except where that is inappropriate for slope stability or safety reasons. This will reduce flood peaks downstream, and improve recharge to the soil and to interflow, improving stream base flows. The streams in these upper catchments are also important fish habitat areas, and this approach is aimed at protecting these as far as practicable as well as mitigating flood flow effects further downstream.

Revegetation

Two types of revegetation are proposed to help implement stormwater management. These are:

- general revegetation to manage stormwater runoff volumes and peaks, and
- riparian planting to protect the stream channels.

General revegetation should be designed to increase interception of rainfall by vegetation, and improve the infiltration to the soil. The emphasis is on a good canopy with a high level of rainfall interception. A build-up of vegetable matter on the ground, and good root structure which opens up the ground and improves infiltration and interflow, are important. This is best achieved by dense forest cover, rather than specimen trees surrounded by grass.

Riparian planting for protection of streams requires low, robust flexible marginal vegetation (i.e. that lies down under flood flows) that can tolerate periodic inundation. There needs to be a succession of such low vegetation close to the stream, through to larger trees back from the stream edge, where practical. Care should be taken to avoid unnecessarily increasing the size of the stream channel. The ideal form is a small main channel with a flood plain capable of conveying flood flows in even quite moderate storm events, as this serves to reduce erosion effects.

The exclusion of stock from stream margins will be essential in providing for protection of the stream and riparian vegetation.

Disposal of stormwater

Stormwater from impervious areas should be disposed to stable ground and flow dissipated over as wide an area as possible, to encourage infiltration rather than runoff. Given that some areas are inherently unstable, care should be taken in the location and disposal of stormwater, and disposal to ground should be confined to areas where the land is stable. Preferably disposal should be at or near the ground surface, to avoid the risk of direct introduction of water at depth, which may lead to increased instability of slopes.

In the event that there is no suitable disposal site on a property, then disposal through water tanks and possible water re-use, or other low impact approaches shall be considered. It is recognised that while this would achieve the flood attenuation objectives, it would not meet the stream baseflow objectives. However, it remains a preferable option to the unmitigated discharge of impermeable area runoff directly to the stream.

Wherever practicable, runoff from public roads should be disposed of in the same way as stormwater from other impervious areas in this zone, that is either by collection and disposal at a suitable site or by direct spill from the road surface to adjacent grassed areas.

Regardless of the disposal method adopted the flow quality and quantity should be treated before discharge to the stormwater management area in the same way as is required for runoff from the balance of the lower lying areas of the Flat Bush catchment, i.e. treated in ponds, filters, swales, raingardens or tanks for contaminant removal, and for extended detention and flood peak attenuation in accordance with the requirements outlined later in this section.

5.2 Middle and lower catchment runoff

Implementation approach

The proposed implementation approach for stormwater management allows for both sub-catchment based management and on-site low impact design approaches. The implementation of the on-site approach will vary, depending on site location, soil conditions and topography. The FBCMIP provides a sufficiently robust regime for both approaches to be used to achieve appropriate outcomes. While low impact design and reduced impervious areas are generally the most effective measures in terms of maintaining stream base flows the high density urban development that is proposed in the middle and lower catchment makes this very difficult to achieve. Therefore a sub-catchment approach, which relies on stormwater collection in ponds before discharge into the protected streams, is necessary to meet the stormwater quality, extended detention and flood peak attenuation criteria.

All stormwater runoff from a development area must be assessed against the design criteria included in this plan. The following design concepts are promoted:

- Discharge through pond systems is anticipated to be the most appropriate method in most situations, and an indicative layout of ponds is shown in Map 9A.
- Where practicable, secondary flow paths should also be directed to ponds, in order to achieve attenuation of larger floods which exceed the capacity of the primary system.
- Since all secondary flow will not be able to be captured in ponds, it is essential that the flood plains and stormwater management areas be retained, as these assist in compensating for areas not captured to ponds.
- Where there are urban margins alongside stormwater management areas from which, due to topography, the runoff cannot be directed through the primary system to ponds, the stormwater can be discharged to the stormwater management area in a diffuse manner.
- Discharge directly to the stormwater management area from adjacent urban development (i.e. not through a pond system) should be to a vegetative filter strip, which should in general be limited to the first 5 m of the stormwater management area. The maximum size of discharge pipe should be 100mm diameter, and such discharges should be limited to one per property, with no provision for combined discharge from multiple properties . The discharge from such pipes should be dissipated to avoid scouring of the vegetative filter strip.
- Where a road runs adjacent to the stormwater management area, the runoff from the road may be discharged to vegetative filter strips alongside the road in the stormwater management area, but the flow shall not be concentrated.

Design concepts are set out in more detail under a later section.

Stream types

The existing character of streams is categorised on Map 8A, and their status in terms of management is identified on Map 9A. There are three types of stream status for management:

- Fully protected streams in stormwater management areas, which are linked to headwater streams and on which there shall be no on-line ponds;
- Streams in stormwater management areas which are not linked to headwater streams, and where on-line ponds are permitted; and
- Lowland ephemeral streams, which may be modified or piped.

In the fully protected streams, all works required in or adjacent to the watercourse shall facilitate fish passage for species such as shortfin eels and banded kokopu.

Where stream tributaries are retained in stormwater management areas, but are not specifically required for upstream fish passage, the approach to stormwater management in these subcatchments allows flexibility to suit site requirements. Principal factors to be considered in design include:

- Whether fish passage is still required and is practicable and if there is to be an open stream channel upstream;
- Ponds may be distributed upstream so long as total system performance is achieved;
- Direct discharge to these streams will be permitted so long as the potential for stream erosion has been adequately addressed.

Stormwater management devices

All stormwater flow from development to fully protected streams shall be treated for contaminant removal, extended detention and flood peak flow attenuation before discharge to the stream. Design approaches are described in a later section.

Contaminants generated as a result of urban development and use of the land shall be treated in accordance with TP10. For specific sites identified as having a moderate to high risk of generating contaminants to the receiving environment, specific on-site source control measures shall be implemented.

Flood prone areas

There shall be no development in flood prone areas where these are identified for the post development urbanised catchment. This applies to both flood plains of principal streams, and to the secondary flow paths designed or identified by each developer.

Developers shall take account of the effects of secondary flow paths from the land upstream of their development, and shall provide for such flows to pass through their development site and on to the downstream land in a manner that avoids damage to property.

All areas with identified flood risk or secondary flow paths shall be identified by the land developer and notified in map form to MCC.

5.3 Protection of streams, stormwater management areas and flood plains

The protected stream system and associated flood plains and stormwater management areas are an integral part of the overall Flat Bush development concept. Variation 13 to the Manukau proposed District Plan requires any development which impacts on these areas to take account not only of the stormwater management effects associated with that development (as covered by this FBCMIP), but also the wider landscape, visual, recreational and planning issues that may be relevant. Those issues are, however, separate from the stormwater management issues and are not covered by this resource consent.

Flood plains

An underlying principle of this FBCMIP is that, as far as practicable the full existing extent of flood plains should be retained. This is to achieve a range of objectives, including:

- flood peak attenuation (especially compensating for flood runoff from areas that cannot be captured to ponds);
- provision of riparian planting and protection of stream habitat; and
- protection of streams from bank erosion.

The modelled existing flood plains are shown in Map 10A, and indicative design flood levels are given in Appendix B. It should be noted that some flood plains fall outside stormwater management areas. At the stage of development of land adjoining flood plain areas, any such flood risk areas must be more accurately mapped for both the pre- and the post-development land form.

Works in stormwater management areas

The protected streams are the backbone of the stormwater management in the Flat Bush Catchment. These streams are identified in Map 9A as fully protected streams without on-line ponds. Fish passage is one of the requirements that affects all structures within the watercourses, and all works which might affect the nature of the watercourse. All ponds shall be off line, shall discharge to the stream (for both primary and secondary flow), and shall be designed to avoid the risk of erosion of the flood plains and the bed and banks of the stream.

The design of bridges, embankments for road crossings and other services crossing the watercourse and flood plains shall be assessed against the following criteria:

- the hydraulic energy loss at the 100 year ARI design flow is to be kept to a practicable minimum (unless greater energy losses are necessary for other purposes such as flood peak attenuation);
- they shall not increase flood level such that the flood plain extends outside the stormwater management area.
- where the structure causes an increase in water velocity at design flow, consideration shall be given to appropriate stream bed and bank protection against erosion, using standard design approaches which are compatible with the natural character of the stream and which protect fish passage;
- any structures on the flood plain that could be an impediment to flow shall include provision to pass that flood plain flow through secondary conduits or over the structure so that the flow remains on the flood plain, rather than being directed back into the main stream channel.

Where other necessary structures are constructed within the stormwater management areas and on other designated overland flow paths (e.g. road crossings, service crossings, stormwater management devices, pump stations etc), these shall be

implemented so that overall flood risk is minimised as far as practicable, and the flood plain storage and conveyance capacity are maintained.

All structures affecting the flood plains, shall be assessed against the following criteria:

- The effects of structures on flood levels shall be specifically determined using the Flat Bush catchment flood model.
- The design and implementation shall provide for the avoidance of erosion both in the principal channel and on the flood plains.
- Any infrastructure that is susceptible to flood risk (e.g., walkways, roads, wastewater pump stations) shall be designed taking appropriate flood levels into account.
- Where works adjacent to the margins of the stormwater management areas require earthworks to improve contours or facilitate drainage patterns, these may include modification of the ground contour within the adjacent stormwater management areas, subject that the finished works do not reduce the flood plain storage or conveyance.

Where the principal stream channel is altered by works either through rehabilitation works, riparian planting or specific infrastructure, rehabilitation of the channel shall provide for variety in bed form and habitat types, including where appropriate pools, runs and riffles.

Specific ARC approval may be required for any works within watercourses.

Riparian planting

Riparian planting is intended to serve two principal purposes:

- provision of stream habitat, and
- protection of the banks from erosion.

Channels in the Flat Bush catchment generally have clay banks, which are typically stable until a critical threshold flow is reached. The risk of erosion is reduced if:

- the main channel size is kept small,
- main channel velocity is reduced, and
- storm flows are directed onto adjoining flood plain areas.

Riparian planting and, where relevant, planting associated with any proposal to modify stream banks shall have the following characteristics:

- Be comprised generally of lower-growing plants that are robust and are able to withstand flood flow velocity (e.g. by lying down under the pressure of water, and not being ripped out by the flow);

- Be planted close to the normal water level, with minimal disturbance of the existing stream bank soils;
- Provide a good transition from the stream edge planting to the higher vegetation behind with provision for the stream flow to move from the main channel onto the flood plain and back without causing erosion;
- Discourage where possible direct public access into the stream bed while retaining provision for safe egress at appropriate intervals.

Planting on the flood plain and stormwater management area

Planting on the wider flood plain area is primarily for ecological, landscape, and aesthetic purposes. However, such plantings shall be designed with flood flows in mind, and therefore should provide for adequate passage of flood flows, avoidance of blockages to flood flow paths, and avoidance of concentrating flows and erosion.

In designing riparian and flood plain planting, in addition to the above criteria, consideration needs to be given to stream habitat and landscape requirements. Use of a suitable planting guide (e.g., ARC TP148 and specific MCC guidelines for the Flat Bush area) is required.

Direct inflows

There will be some areas where flows discharge directly to the stormwater management areas from adjacent developed land, without passing through ponds. In the design of the stormwater management areas allowance must be made for this flow to pass across the flood plain and to the stream channel. The design should as far as practicable avoid concentrating or channelising this flow.

Adjustment of the stormwater management area

The extent of the stream stormwater management areas has been set taking a number of factors into account, including some not directly related to stormwater management. Variation 13 together with the FBCMIP provide flexibility for the stormwater management area to be reduced in area following a detailed assessment. Any change to the extent of the stormwater management areas, shall meet the following minimum criteria:

- The 100 year ARI flood plain associated with the stream channel shall be totally contained within the stormwater management area;
- Significant stormwater devices (e.g. ponds) shall be contained within the stormwater management area;
- Allowance shall be made for any expected lateral migration of the stream channel due to bank erosion;

- Sufficient additional space outside the 100 year flood plain to allow for maintenance requirements along both sides of the stormwater management area.

Development, including filling in or encroachment onto existing flood plain areas, will be allowed only in limited areas where it will not lead to unacceptable increases in flooding, erosion or other adverse effects in adjacent, upstream or downstream areas. In any other areas not provided for below, a resource consent from the ARC will be required. Filling will be acceptable in principle where specifically identified at the town centre, between nodes 70 to 30, between nodes 60 to 50, on ephemeral tributary gullies that may be piped or where outside stormwater management areas or where associated with permitted crossings. Any filling shall not result in the flood plain width being narrower than is noted in Maps 10A and 11A.

- The waterways may be made wider than the minimum widths that are shown on maps 10A and 11A where considered necessary to integrate with the form of the adjoining development. e.g. the alignments of abutting park edge roads, or adjoining lot boundaries.

5.4 Town centre area

The general town centre area includes both the Town Centre and adjacent areas of high density housing. The Council is the current owner of part of the Town Centre zoned land and accordingly will be in a strong position to take a long-term view to facilitate the development of a community orientated Town Centre. Council intends to establish a Steering Group consisting of community representatives, Councillors and technical experts to advise on the most appropriate way to develop the centre. Therefore it is unlikely that Council will be the direct developer and long-term owner of the Town Centre. However, the final decision is a "strategic" one and falls outside of the scope of the Resource Management Act and the District Plan.

The Town Centre land was originally purchased within the block of land known as Sir Barry Curtis Park. However, it was never intended that all of the land purchased would be used for park land.

For town planning reasons rather than those related to stormwater management, part of this area encroaches onto the existing flood plains. In order to facilitate the town planning requirement this area will be filled as part of the development. This provision has been specifically modelled, and mitigation has been allowed for the development as set out in Map 11A. This comprises the following:

- A diversion of the upstream lowland catchment away from the town centre and towards the principal stream to the north;
- Treatment of the discharge from the lowland catchment upstream of the town centre before discharge to the stormwater management area;
- Filling into the flood plain in the areas identified in Map 11A;

- Retention of the existing stream channel around the north side of the site, as part of a flood plain and sufficiently wide stream corridor (refer Map 11A).

5.5 Stormwater System Design Criteria

Design standards and guidelines

The design of stormwater management systems (including primary, secondary and treatment devices) shall follow the design standards set out in appropriate MCC and ARC guidelines. In particular, these include but are not limited to:

- MCC Engineering Quality and MANARC Standards;
- ARC TP108 for calculating design flow;
- ARC TP10 for design of stormwater quality improvement devices and flood flow management structures.
- Map 7 and Table 11 from the CCMP.

Impervious areas

Impervious area assumptions shall be based on the maximum allowable building coverage figures set out in the Manukau District Plan (including Variation 13) plus an allowance for driveways, paths and patios – Guideline Values for design purposes are:

Table 5.1

Typical Impervious area assumptions

Land use type	*Coverage range (%)*	*Additional impervious (%)*	*Total impervious area (%)*
Flat Bush Town Centre	80	20	100
Flat Bush Neighbourhood Centre	80	15	95
Flat Bush Residential 1	35 - 55	20 – 25	55 - 80
Flat Bush Residential 2	40 - 45	20 – 25	60 - 70
Flat Bush Countryside Transition	15	0-5	15 – 20

Note:

1. Where coverage varies from the values given above, the impervious area ratio shall be calculated as the coverage for that zone as contained in the District Plan, plus an appropriate value for additional paved surfaces based on the nearest equivalent zoning set out in the table above.

2. Figures may also be adjusted to take account of activities (land uses) which are likely to have a higher proportion of permeable surfaces (for example: local reserves, larger lots, schools).

Primary and secondary stormwater system

The primary stormwater system shall be designed for a 5 year ARI storm event as per MCC standards, and generally shall convey flows to ponds before discharge to protected streams.

Secondary flow paths shall be provided for all development areas. These shall be designed to protect buildings and principal infrastructure from inundation in the maximum 100 year ARI flood with an adequate freeboard in accordance with MCC standards. These secondary flow paths shall be identified on development plans submitted to MCC, including both the flood levels and extent of land affected by flow or ponding. Where secondary flow paths are not directed to ponds, they shall be directed to the stormwater management areas, with provision to minimise erosion along the route and at the point of confluence with the main channel.

Flood flows and levels

Appendix B gives target flood levels and flows at key nodal points through the drainage system. Where design flows are required at intermediate points, a reasonable estimate of these design flows may be obtained by interpolation using the relationship $Q_{flood} \propto A^{0.8}$ (where Q is the flood peak flow, and A is the associated catchment area at the respective points) to adjust flow values from upstream or downstream reaches.

Where flows are used to calculate flood levels, account must be taken of backwater effects.

5.6 Stormwater management ponds

Objectives

Ponds shall be designed to achieve three principal objectives:

- Protection of the receiving environment quality through removal of contaminants from stormwater, using processes of settlement in a wet pond, extended detention, filtration, passage through wetlands or vegetated strips, or a combination of these;
- Mitigation of potential stream erosion through significant attenuation of frequent floods to well below the pre-development level, using extended detention for the runoff from 34.5 mm of rainfall discharging over 24 hours;
- Mitigation of downstream flood risk through attenuation of the 100 year ARI flood to peak flows as shown in Appendix B, or approximately 80% of the predevelopment flood peak.

The indicative peak flow target for each subcatchment in the 100 year ARI flood has been set at 80% of pre-development peak based on the catchment hydrological model. This is to compensate for the increased volume of runoff as a result of development. Attenuation of this runoff in ponds considerably extends the duration of subcatchment peak flows, resulting in a greater coincidence of peaks and therefore a greater combined downstream discharge than occurs in the pre-development situation. The indicative target is necessary to avoid any cumulative hydrological effects that could increase the peak flow in the lower Otara Creek.

Design approach

The stormwater quality volume and the extended detention volume for stream erosion protection may be partially combined to reduce total pond size, so long as both functions are fully achieved.

The extended detention provision will substantially mitigate the increase in 2 year ARI flood, but the implementation must still provide for the 2 and 10 year peak flows to be no more than the predevelopment peak flows, and the 100 year ARI peak flow to be as per Appendix B, or 80% of the predevelopment peak.

Design of stormwater quality ponds and extended detention shall be in accordance with ARC TP10. ARC TP108 shall be used to calculate the runoff from 34.5 mm of rainfall.

The calculation of peak flows shall account for both primary and secondary flow, including any secondary flow that does not pass through the ponds. Where significant areas of secondary flow do not discharge through ponds, where practicable this shall be mitigated through an on-site approach and/or greater retention of that flow which does reach the pond.

All ponds shall be built with provision of appropriate access for future maintenance, including where necessary appropriate widths, surfacing and gradients for trucks.

Subcatchment definition and pond locations

The ponds shown in Map 9A have been located so that in general they capture as much flow as possible from each upstream subcatchment. Thus the subcatchment boundaries for post development are often drawn along the side of the stormwater management area, to indicate that there should be primary system conveyance along these stormwater management area margins that will capture primary stormwater flows.

- It is possible that during the urbanisation process it may be necessary to change the location of ponds so that they better match a particular development staging or drainage layout, or function more efficiently. The pond locations in Map 9A are indicative only, and may be altered subject to the following criteria: Where ponds are shown as off-line from protected streams in Map 9A, the alternate ponds shall also be off-line from those streams;
- The same overall subcatchment stormwater management objectives and performance (relative to catchment area) shall be achieved for the new ponds or devices as for the pond that is being replaced;

- The change of location or subcatchment boundaries shall not compromise the serviceability of other properties within that catchment;
- The extent of the stormwater management areas shall be modified as required to ensure they include the new pond locations.

Any such changes shall be subject to MCC approval.

The proliferation of many small ponds should be avoided as far as possible.

Responsibility for device implementation

Where a pond is fully contained within and services one development block, it is likely to be most appropriate that the developer takes full responsibility for building the pond in a way that fits the proposed development. Where a pond is contained within a single development block, but also services other blocks, a similar approach may be appropriate for the pond's construction, but with appropriate adjustment of developer's stormwater financial contributions and/or credits. In a situation where development is fragmented, MCC would undertake the construction of the pond on behalf of the various development blocks.

Ongoing maintenance will be the responsibility of MCC, once development is complete and the pond rehabilitated by the pond developer to remedy any effects of sedimentation that arise during the development phase.

5.7 Commencement of development

Erosion and sediment control

As soon as topsoil is stripped and earthworks commence, there is an increased risk of soil erosion and discharge of sediment. There is also an increase in the volume and peak flow of runoff from the site compared to a predevelopment situation.

The soil erosion risk is required to be mitigated by the application of erosion and sediment control techniques, in accordance with ARC TP90.

These measures, where they involve a pond, will also assist in mitigating the effects of increased runoff, but in many cases will not fully meet the performance standards required of this CMIP.

Implementation of permanent ponds

The risk of sediment runoff continues after the site development phase and into the building phase, during which stage there may be no TP90 provisions in place.

Therefore, in addition to the TP90 provisions, the permanent stormwater ponds shall be constructed as part of the first stage on development on the site. As far as possible, discharge from the construction site would discharge from the TP90 ponds to the permanent pond, until such time as the permanent drainage system is in place (also discharging to the permanent pond).

On completion of construction, the TP90 ponds will be decommissioned, and at this time it will also be necessary to thoroughly clean the permanent ponds.

Similarly, on completion of the building phase in the contributing catchment, it will be necessary to again completely clean the permanent ponds and rehabilitate them for long term operation.

Staging of stormwater devices

There will be occasions when the staging of development does not readily facilitate the above approach. In these situations practicable alternatives will be necessary, which may include staging of devices, and a greater number of smaller temporary devices. In all such situations, the development process shall provide for:

- Full erosion and sediment control and stormwater management to the standards set out in this FBCMIP;
- Coverage to include any and all development sites within the subcatchment;
- Provisions to cover the full development cycle from initial site works through to implementation of the permanent stormwater management works;
- Any permanent works used during development for sediment control, or as a backup to sediment control works, are to be rehabilitated on completion of subdivision development in the subcatchment and prior to it vesting in the Council.

5.8 Monitoring, operation and maintenance

An appropriate monitoring programme is an essential part of the operation and maintenance of the stormwater management system outlined in this CMIP. The following minimum monitoring and maintenance shall be performed by MCC:

S***treams***

Check annually for stream bank erosion and/or blockage by vegetation. Carry out remedial work as required to avoid further damage or loss of function.

Stormwater ponds

Initially check twice yearly for sediment accumulation in the forebay, and annually for the remainder of the pond. Carry out any maintenance of flow control structures and check for erosion after storms larger than a 2 year ARI event. Develop a long term maintenance programme based on the observed accumulation rate for sediment.

Contaminants

Carry out sediment sampling for contaminants in accordance with the city-wide sampling programme.

Rainfall

Install at least one raingauge at a site representative of the Flat Bush catchment. A site in the general vicinity of catchment B8 or B11 would be appropriate.

Flows

In association with the ARC, maintain a flow recording site in the lower catchment, and monitor the hydrological effects of development including flood peaks, average flows and low flows.

Model update

As more accurate survey data becomes available, and development proceeds in the catchment (including as-built details of drainage systems and ponds), Council will update the hydrologic and hydraulic model at 5 yearly intervals. Council will use the updated model as a tool for assessing the effects of both individual developments and of the catchment-wide development.

FBCMIP Review

The FBCMIP shall be reviewed on a 5 yearly basis and, if necessary, updated to reflect changing circumstances as a result of development, and of any changes to regional standards.

6 How to use this FBCMIP

This FBCMIP provides guidance specifically related to the development and management of the Flat Bush area. It should be used to determine the appropriate devices to be installed, and the appropriate practices for stormwater management through the area.

For specific rules relating to development, reference should be made to the District Plan.

For guidance of engineering design standards for infrastructure, reference should be made to the MCC Engineering Quality and MANARC standards.

For general guidance on various stormwater management and planting practices, reference shall be made to MCC or ARC guidelines, or such relevant guidelines as MCC or ARC may develop in the future.

This CMIP is the basis on which MCC has obtained a comprehensive discharge consent for stormwater management in the catchment. Development and building activities within the catchment must comply with its terms and conditions. This applies both to the activities undertaken by MCC itself, and those undertaken by other parties for public or private purposes under the authorisation of MCC.

Where this CMIP does not specifically address a particular location or issue, then the appropriate course of action to be followed should be based on the principles set out in this CMIP.