



Geotechnical Report No 2447

# Reids Central Floodway Stopbank Stability Assessment

Environment Bay of Plenty

**Opus:** *an accomplished work,  
a creation, an achievement*

*Geotechnical Report No 2447*

**Reids Central Floodway  
Stopbank Stability Assessment**  
Environment Bay of Plenty



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# **Reids Central Floodway Stopbank Stability Assessment**

**Environment Bay of Plenty**

Prepared By

  
David Dennison  
Principal Geotechnical Engineer

Opus International Consultants Limited  
Hamilton Office  
Opus House, Princes Street  
Private Bag 3057  
Hamilton, New Zealand

Telephone: +64 7 838 9344  
Facsimile: +64 7 838 9324

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## 1 Introduction

Environment Bay of Plenty has an ongoing programme of reviewing the stability of stopbanks in the flood protection scheme, which has identified a potential for slips or piping failure in some areas. The assessment programme has concentrated on the main stopbanks on the Rangitaiki River. In general, the stopbanks on Reids Central Floodway are lower and are in less critical locations. Three trial sections on the Reids Central Floodway stopbanks were selected to assess the risk of a stopbank breach in future floods.

Reids Central Floodway is a key element of the Rangitaiki-Tarawera flood protection scheme. The floodway takes flows from the main channel of the Rangitaiki River about 3.5km upstream of Edgecumbe and rejoins the main river one kilometre above the river mouth at Thornton. The floodway was designed to commence operation at a river flow of 620 cu m/s. During the 2004 flood, the flood had started to flow over the spillway into the Reids Central floodway prior to the stopbank breach at Sullivans bend that spilled into the floodway at flow rates more than 2 times its design capacity.

This report addresses seepage and stability issues associated with the stopbanks, but does not assess hydraulic issues in the scheme, such as overtopping.

## 2 Site Investigation

Ground surface profiles for the three trial sections were provided by Environment Bay of Plenty, as shown on Figures 1 to 3.

Eight boreholes were put down at the three trial sections to depths of four to five metres. Boreholes were drilled using a hollow stem auger rig, supplied and operated by Perry Drilling of Tauranga.

Subsurface conditions were recorded by our Engineering Geologist in the field. Borehole logs for the following Boreholes are appended to this report. Borehole locations are summarised in the table below:

	Section 5	Section 6	Section 7
<b>Crest of Stopbank</b>	BH 5a	BH 6a	BH 7a
<b>Toe of Stopbank</b>	BH 5b	BH 6b	BH 7b
<b>50m from Toe</b>	BH 5c	BH 5b	Not drilled

## 3 Subsurface Conditions

Downstream of Edgecumbe, the Reids Central Floodway traverses an area underlain by Taupo Pumice Alluvium and Peat soils. The ground surface is generally flat pasture.

Brown silty topsoil covers the area over a depth of about 50mm to 300mm.

Descriptions of boreholes in the embankment (BH5a, 6a and 7a) indicate that the stopbank fill is generally fine to medium sand, with some layers of silty soils and a few zones of coarse sand.

Embankment foundations consist of layered deposits of silt, silty sand and peat soils. Layer thickness is generally on the order of a few hundred mm. There are occasional layers of medium or coarse sand, but they tend to be less than one metre thick and are not continuous from borehole to borehole.

## 4 Analysis

The Geoslope suite of computer modelling tools (Seep/w and Slope/w) was used to assess the potential for piping and slumping types of embankment failure. A finite element model was used to estimate the distribution of pore water pressures within the embankment and foundation and also the hydraulic gradient at the surface of the downstream side of the embankment. Foundations soil types vary over short distances and were modelled as a single unit with composite properties of the various soil types as shown in the attached figures. It is a key assumption in these models that the foundation soils are significantly less permeable than the embankment fill soils.

Some stopbanks constructed of finer grained soils may withstand high river levels for a significant period of time before steady state seepage conditions are formed within the stopbank. In this case, the embankments are constructed of fairly permeable sands and initial calculations showed that steady state seepage conditions are established within a period of hours, or very few days. Seepage modelling was therefore carried out with steady state boundary conditions.

The critical seepage exit grading for the initiation of piping in cohesionless soils is given by the following equation:

$$i_c = \frac{\gamma'}{\gamma_w} \cos(\alpha)$$

The factor of safety against piping is defined as the critical gradient ( $i_c$ ) divided by the component of the hydraulic gradient perpendicular to the downstream slope ( $i_{\text{exit}}$ ).

The Slope model then calculated the Factor of Safety for shear failure, using Morgenstern-Price stability method with the porewater pressures determined by the Seep model. In some cases the critical slip circle was extremely shallow and only slip circles that reached the canal side of the stopbank were considered.

Soil properties were estimated from descriptions of soils in the borehole logs, typical properties of similar soils and lab testing of samples from other parts of the river protection system.



Parameter	Topsoil	Embankment Fill	Foundation
$K_{\text{horizontal}}$ , m/s	$5.8 \times 10^{-6}$	$5.4 \times 10^{-5}$	$5.0 \times 10^{-7}$
$K_{\text{vertical}}$ , m/s	$5.8 \times 10^{-6}$	$2.7 \times 10^{-5}$	$1.0 \times 10^{-7}$
$\gamma$ , kN/m <sup>3</sup>	18	18	18
$\phi$ , degrees	28	33	30
$c'$ , kPa	0	0	0

Seepage and slope stability models for the three trial sections are shown in Figures 1 to 3. Results of the modelling are summarised in the following table:

Section	River Level	Stability FoS	Piping FoS
Section 5 3.2H:1V	Bankfull 500mm Freeboard	0.96 1.31	1.77 -
Section 6 4.0H:1V	Bankfull	1.29	1.30
Section 7 10H:1V	Bankfull	4.2	27

The results of the modelling tend to agree with analytical assessments for slopes where the main seepage and stability issues are confined to the embankment fill. For this case, if a soil is cohesionless ( $c'=0$ ), the Bishop simplified equation reduces to:

$$FoS = \frac{\tan(\phi')}{\tan(\alpha)} (1 - r_u \sec^2(\alpha))$$

For cases where the slope is homogeneous, with a parabolic top flow line and a high water table, the pore pressure coefficient ( $r_u$ ) can be estimated by the following equation:

$$r_u = \frac{\gamma_w}{\gamma} \cos(\alpha)$$

The critical batter slope angle for an estimated soil friction angle ( $\phi'$ ) of about 30 degrees is 4(H):1(V).

## 5 Discussion

Section 7, which has is buttressed by a very flat slope, shows little risk of failure. Section 5 is the highest and steepest of the trial sections. It is unstable at bankfull river levels, but has a reasonable degree of safety when the flood level is 500mm below the crest level.

From these results it appears that the stopbanks in this area have a reasonable degree of safety against slumping and piping types of failures when the slope of the bank is less than about 4(H):1(V) and the height of the stopbank is less than about 3m.

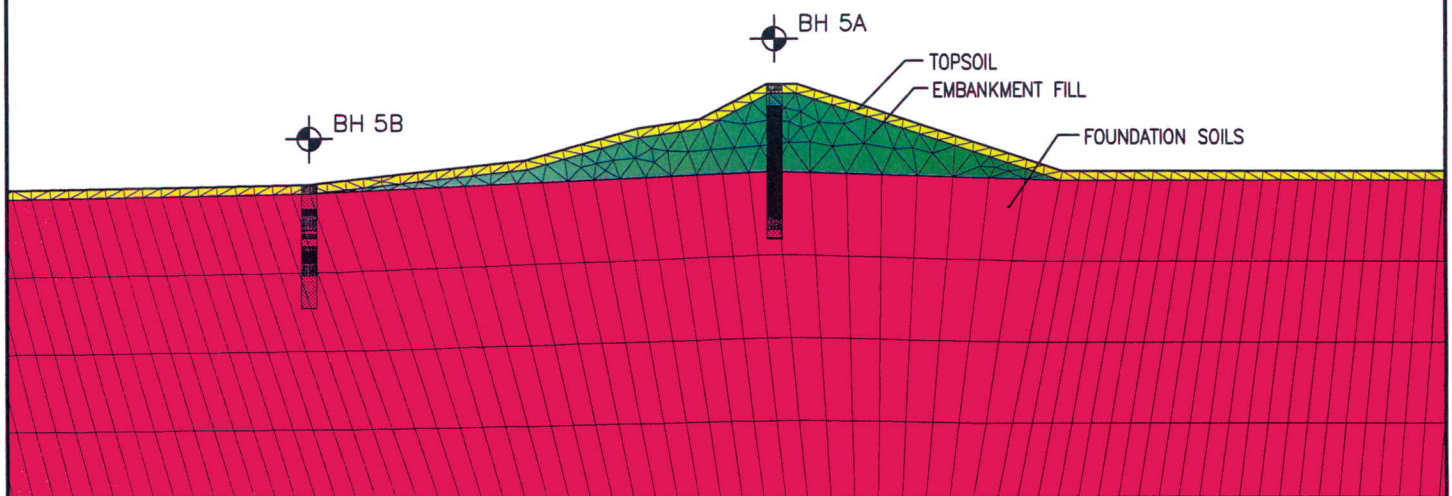
It is possible that more unfavourable soil conditions may exist at other sections, or between the boreholes. There may be some areas where there is a thin layer of low permeability soils capping a more permeable layer which may benefit from toe drains or pressure relief wells.

The analysis did not highlight any stability issues with the trial sections for flood levels up to the top of the bank for Sections 6 and 7. Section 5 can handle flood levels up to 500mm below the crest, but may become unstable in floods up to the crest level. We recommend that future investigations of the stopbanks in the Reids Floodway below Edgumbe should concentrate on the following areas:

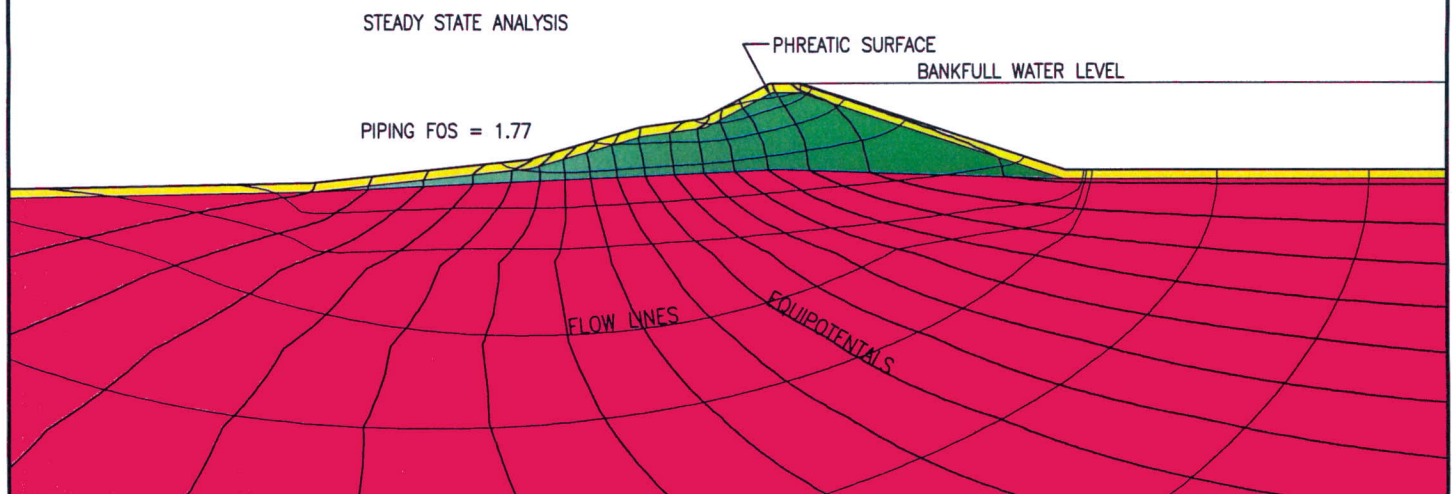
- Any areas where there are indications of defects, such as reported soft spots/sand boils during floods, erosion or scour damage, etc, or;
- Areas where the slope of the stopbank is steeper than about 4(H):1(V)
- Areas where the stopbank crest is higher than about 3 m above the surrounding land.



## STOPBANK MODEL

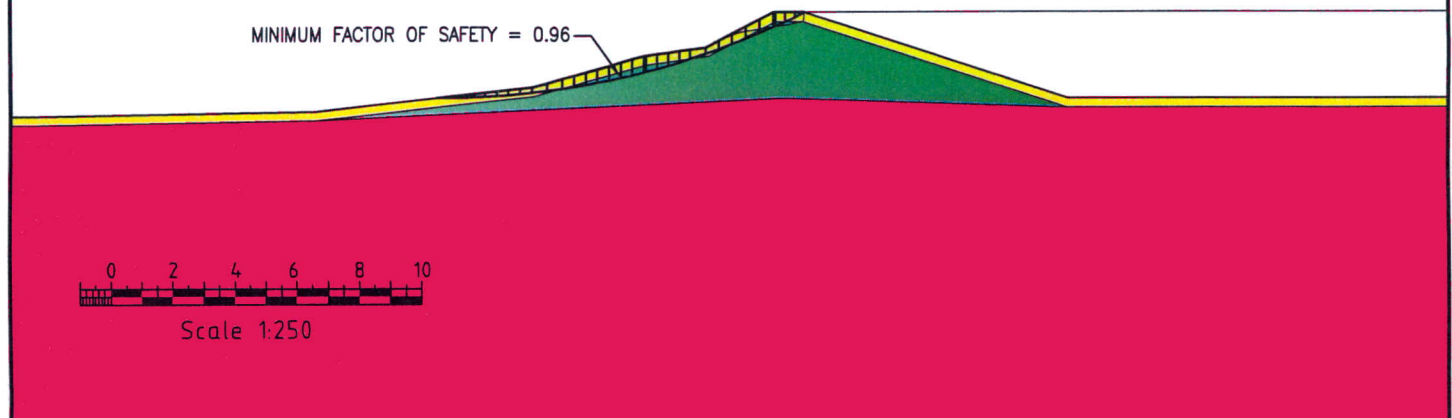


## SEEPAGE MODEL



## STABILITY MODEL

MORGENSTERN PRICE STABILITY METHOD  
USING POREWATER PRESSURES FROM SEEPAGE MODEL



ENVIRONMENT BAY OF  
PLENTY

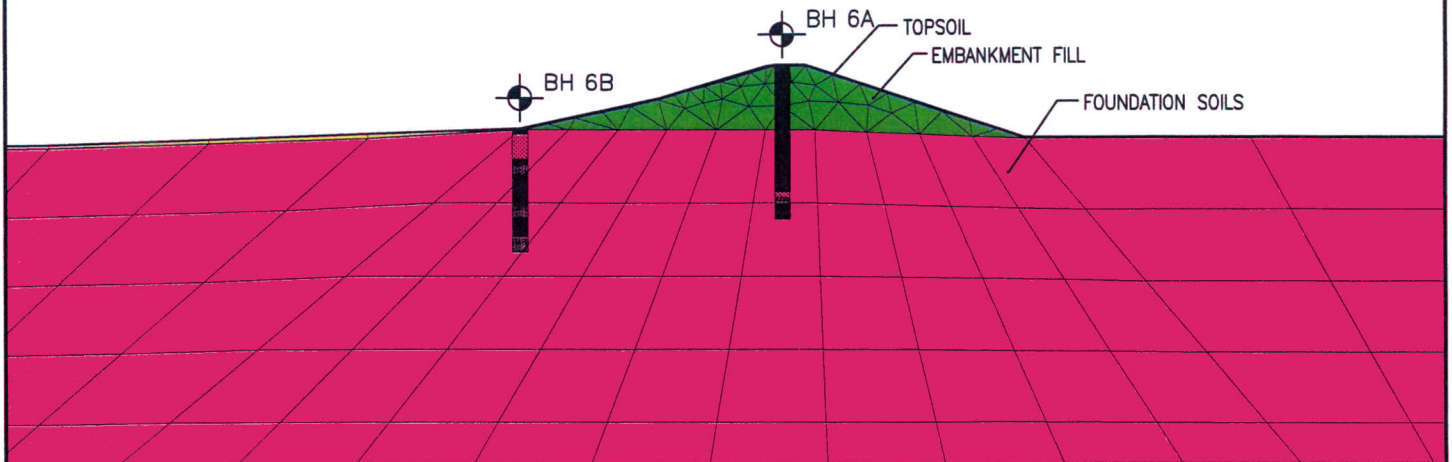
AUG 2006

2-89230.00

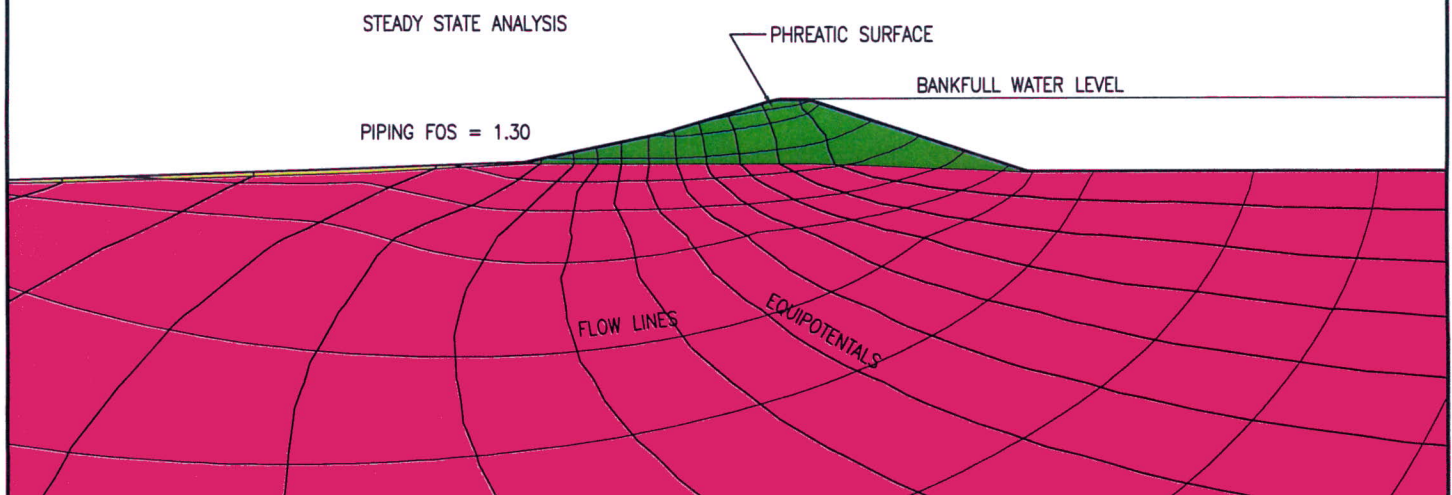
**FIGURE 1**

CROSS SECTION 5  
SEEPAGE AND STABILITY MODELS

## STOPBANK MODEL



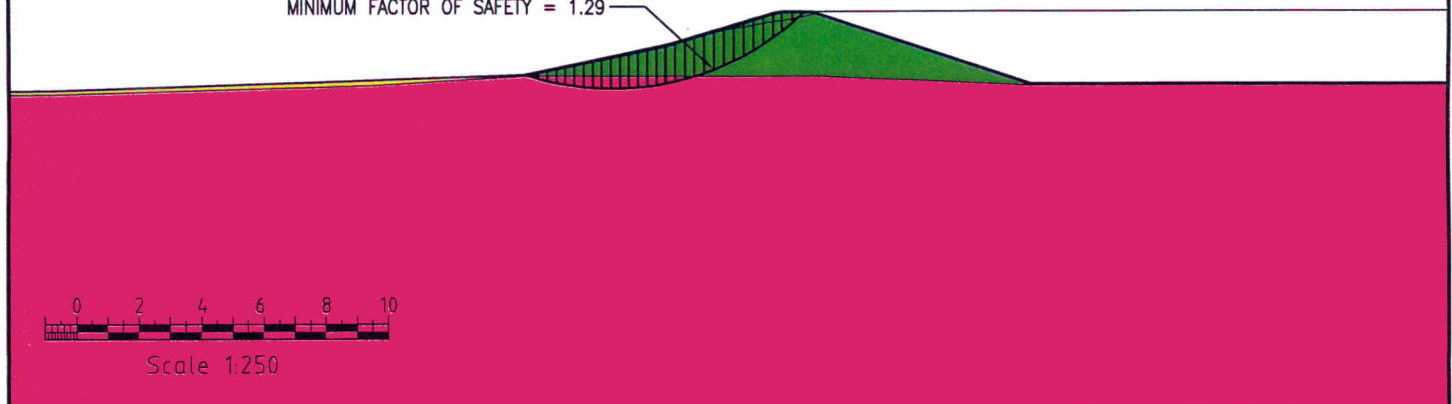
## SEEPAGE MODEL



## STABILITY MODEL

MORGENSTERN PRICE STABILITY METHOD  
USING POREWATER PRESSURES FROM SEEPAGE MODEL

MINIMUM FACTOR OF SAFETY = 1.29



ENVIRONMENT BAY OF  
PLENTY

AUG 2006

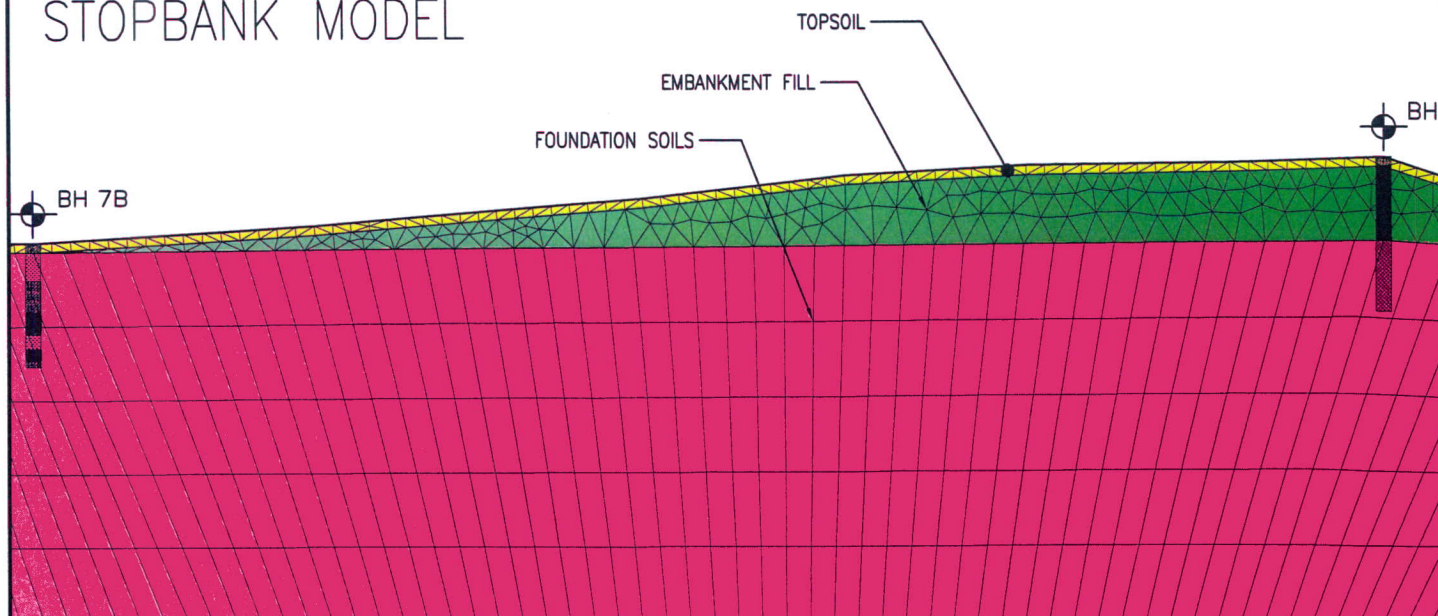
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**FIGURE 2**

CROSS SECTION 6  
SEEPAGE AND STABILITY MODELS

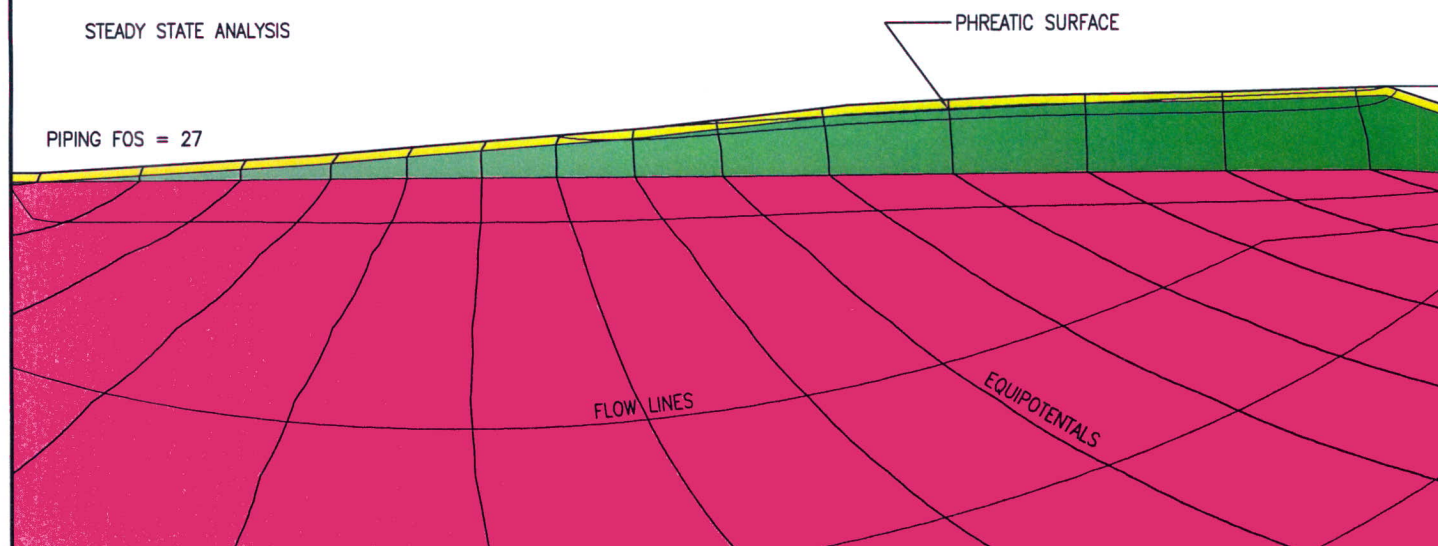


## STOPBANK MODEL



## SEEPAGE MODEL

STEADY STATE ANALYSIS



## STABILITY MODEL

MORGENSTERN PRICE STABILITY METHOD  
USING POREWATER PRESSURES FROM SEEPAGE MODEL

MINIMUM FACTOR OF SAFETY = 4.2



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**FIGURE 3**

CROSS SECTION 7  
SEEPAGE AND STABILITY MODELS



Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

Page: 1 of 1

Borehole No: 5a

Project Name: Edgcumbe Flood Mitigation Study  
Client: Environment Bay of Plenty  
Location: Edgcumbe  
Project No. 2-89290.00 Lab Ref. 06/352/001

Co-ordinates:

Grid:

Elevation: Not Established

Datum:

Inclination: Vertical

Azimuth:

Depth	Drilling Method	Casing	Ground Profile		Samples		Additional Lab Tests/Notes	Piezometer Installation
			Description	Graphic Log	Depth/Elev	Type Recovery		
0			Ground Surface		0.00			
			<b>TOPSOIL</b> Brown SILT (TOPSOIL), moist, soft-firm, slightly plastic.					
			<b>Sandy SILT</b> Light brown white flecked very fine Sandy SILT, dry-moist, firm, slightly plastic.		0.20	A 67		
			<b>SAND</b> Grey very fine SAND, dry-moist, "loose", non plastic.		0.70			
			<b>SAND</b> Brown white flecked medium SAND, trace of fine Gravel, dry-moist, "loose", non plastic. Some fine Sand beds at 1.0-1.05, 1.02-1.25, 1.1-1.15, 1.9-1.95		0.80	A 100		
						A 100		
			<b>Silty SAND</b> Brown white flecked Silty SAND, dry-moist, "loose", non plastic.		2.00			
			<b>SAND</b> Grey coarse SAND, some fine-coarse pumice Gravels, "loose", dry-moist, non plastic.		2.25	A 100		
			<b>SAND</b> Grey orange mottled fine Sand, some Silt, trace white flecks, moist-wet, "loose-medium dense", non plastic.		2.80	A 100		
						A 100		
			<b>Organic SILT</b> Brown organic SILT, slightly fibrous, moist-wet, soft, slightly plastic.		4.30			
			<b>SILT</b> Very light greyish brown SILT, moist-wet, soft, slightly plastic-moderately plastic.		4.70	A 100		
			<b>Organic SILT</b> Brown organic SILT, slightly fibrous, moist-wet, soft, slightly plastic.		4.95			
			End of Log					

Remarks:

PT=Push tube

SPT=Standard Penetration Test

Logged: S Amore

Date: 28/6/06

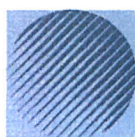
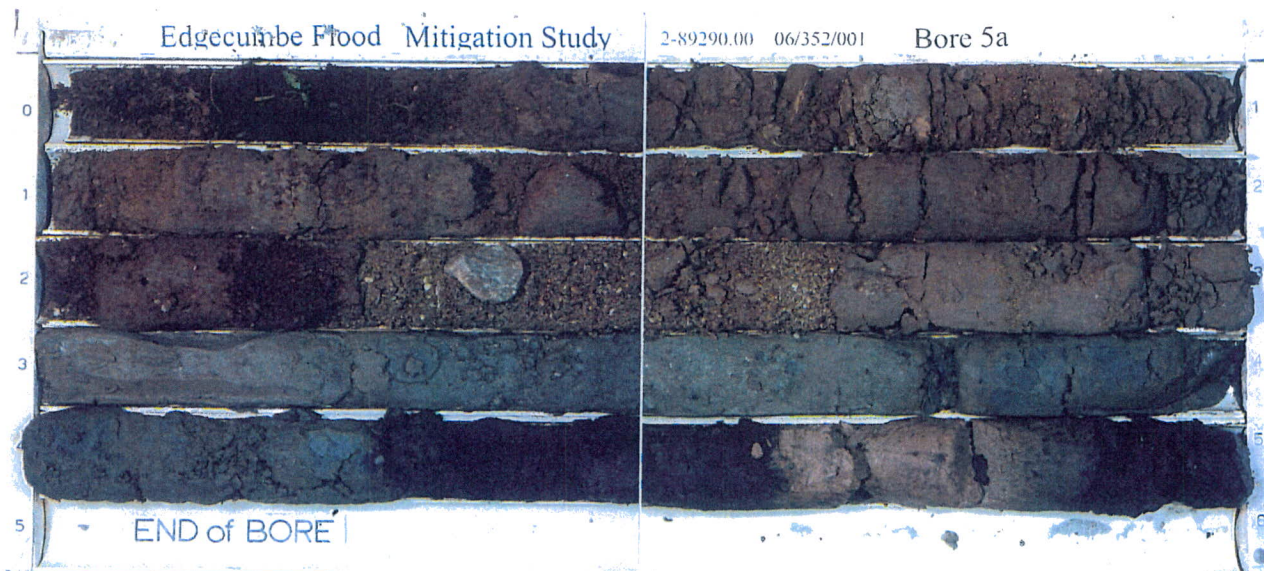
Checked:

Drill Rig: Perry Drilling - Tractor Rig

Start Date: 28/6/06

Finish Date: 28/6/06

Scale:



**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH5a



Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

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**Borehole No: 5b**

**Project Name:** Edgecumbe Flood Mitigation Study  
**Client:** Environment Bay of Plenty  
**Location:** Edgecumbe  
**Project No.** 2-89290.00 **Lab Ref.** 06/352/001

**Co-ordinates:**

**Grid:**

**Elevation:** Not Established

**Datum:**

**Inclination:** Vertical

**Azimuth:**

Depth	Drilling Method	Casing	Ground Profile		Samples		Additional Lab Tests/Notes	Piezometer Installation
			Description	Graphic Log	Depth/Elev	Type Recovery		
			Ground Surface					
0			<b>TOPSOIL</b> Brown SILT (TOPSOIL), wet, soft, slightly plastic.	x x x	0.00			
			<b>Sandy SILT</b> Grey orange mottled fine Sandy SILT, trace medium-coarse Sand, moist-wet, firm, slightly plastic.	x x x	0.20			
			<b>Sandy SILT</b> Grey orange mottled fine-medium Sandy SILT, trace coarse Sand and fine Gravel, moist-wet, firm, slightly plastic.	x x x	0.37	A 100		
			<b>Silty SAND</b> Grey Silty fine SAND, moist-wet, "loose-medium dense", non plastic.	x x x	0.75			
1			<b>SAND</b> Grey fine-medium SAND, some fine pumiceous Gravels and coarse Sand, saturated, "loose", non plastic.	x x x	1.00	A 100		
			<b>Organic SILT</b> Dark brown organic SILT, wet, soft, slightly plastic-non plastic.	x x x				
			<b>SILT</b> Greyish brown SILT, wet-saturated, soft, slightly plastic.	x x x	1.48			
			<b>Organic SILT</b> Brown organic SILT, moist-wet, firm, slightly plastic, some fibrous material.	x x x	1.60			
			<b>SILT</b> Greyish brown SILT, wet, very soft, slightly plastic.	x x x	1.75	A 100		
2			<b>Organic SILT</b> Brown organic SILT, moist-wet, firm, slightly plastic, some fibrous material.	x x x	2.00			
			<b>SAND</b> Greyish white medium-coarse SAND, saturated, "loose", non plastic.	x x x	2.15			
			<b>PEAT</b> Dark brown fibrous PEAT, wet, very soft, slightly plastic-non plastic.	x x x	2.55	A 100		
3			<b>Sandy SILT</b> Grey very fine Sandy SILT, some fine-coarse pumice Gravels, wet, firm, slightly plastic.	x x x	2.95			
				x x x		A 0		
				x x x		A 0		
4			End of Log		4.00			
5								
6								

**Remarks:**

PT=Push tube

SPT=Standard Penetration Test

**Logged:** S Amore

**Date:** 29/6/06

**Checked:**

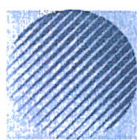
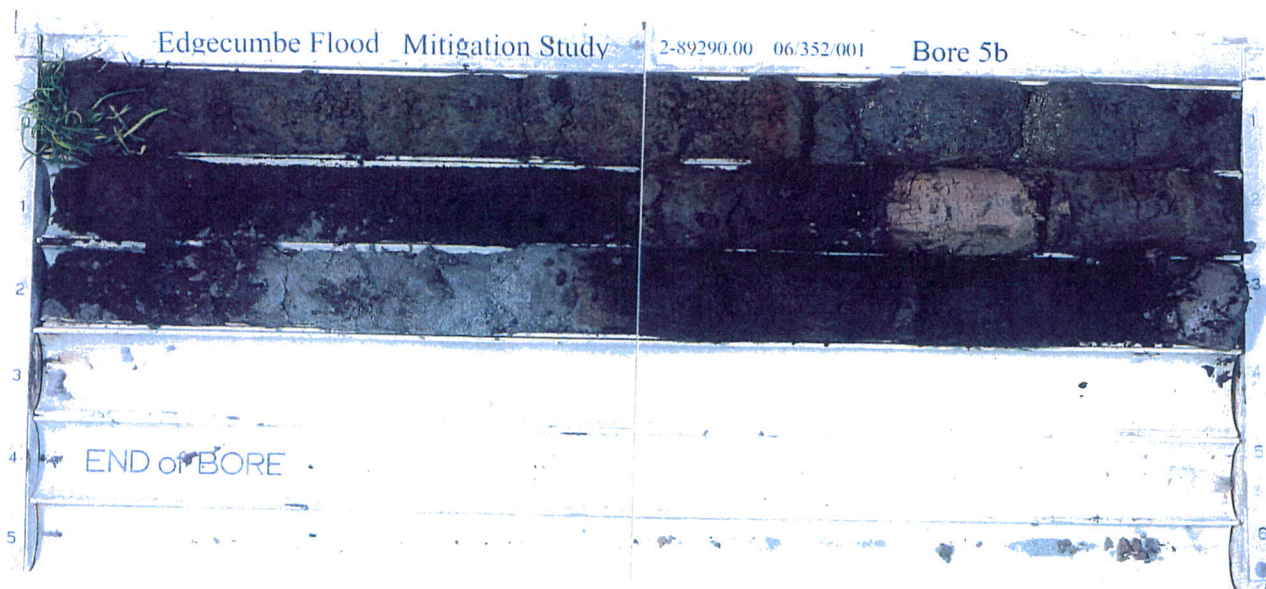
**Drill Rig:** Perry Drilling - Tractor Rig

**Start Date:** 29/6/06

**Finish Date:** 29/6/06

**Scale:**





**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH5b





Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

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**Borehole No: 5c**

**Project Name:** Edgumbe Flood Mitigation Study  
**Client:** Environment Bay of Plenty  
**Location:** Edgumbe  
**Project No.** 2-89290.00 **Lab Ref.** 06/352/001

**Co-ordinates:**

**Grid:**

**Elevation:** Not Established

**Datum:**

**Inclination:** Vertical

**Azimuth:**

Depth	Drilling Method	Casing	Ground Profile		Samples		Additional Lab Tests/Notes	Piezometer Installation
			Description	Graphic Log	Depth/Elev	Type Recovery		
			Ground Surface					
0			<b>TOPSOIL</b> Brown SILT (TOPSOIL), wet, soft, slightly plastic.	x x x x	0.00			
			<b>SILT</b> Brown grey orange mottled SILT, moist-wet, soft, slightly plastic.	x x x x	0.20	A	53	
			<b>SAND</b> Grey medium SAND, trace of fine black flecks, saturated, "loose", non plastic.	x x x x	0.40			
1			<b>PEAT</b> Dark brown PEAT, slightly fibrous, wet, very soft, slightly plastic-non plastic.		1.00	A	87	
						A	73	
2			<b>Silty SAND</b> Grey Silty very fine SAND, some fine pumice Gravels, wet, "loose", slightly plastic-non plastic.	x x x x	2.00	A	100	
				x x x x				
3			<b>SAND</b> Grey medium-coarse pumiceous SAND, saturated, "loose-medium dense", non plastic.	x x x x	2.90			
			<b>Organic SILT</b> Lightish brown organic SILT, some fresh tree root, saturated, very soft, slightly plastic.	x x x x	3.20	A	67	
				x x x x		A	0	
4			End of Log		4.00			
5								
6								

**Remarks:**

PT=Push tube

SPT=Standard Penetration Test

**Logged:** S Amore

**Date:** 29/6/06

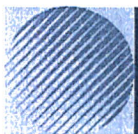
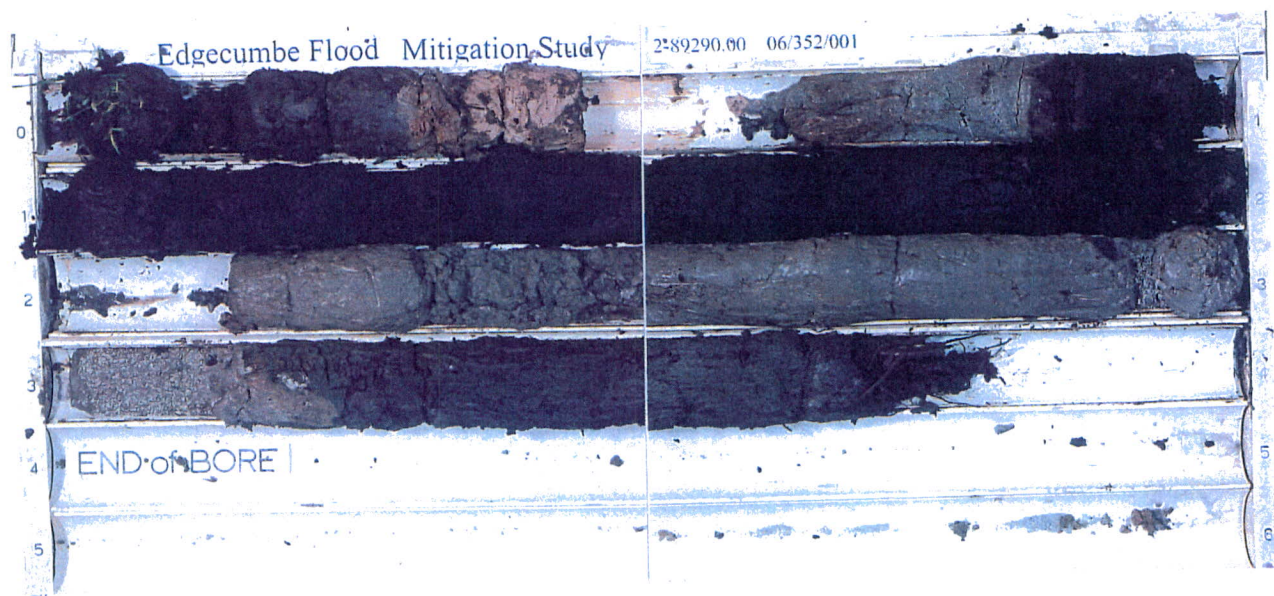
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**Drill Rig:** Perry Drilling - Tractor Rig

**Start Date:** 29/6/06

**Finish Date:** 29/6/06

**Scale:**



**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH5c



Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

Page: 1 of 1

**Borehole No: 6a**

**Project Name: Edgecumbe Flood Mitigation Study**

**Client: Environment Bay of Plenty**

**Location: Edgecumbe**

**Project No. 2-89290.00 Lab Ref. 06/352/001**

**Co-ordinates:**

**Grid:**

**Elevation: Not Established**

**Datum:**

**Inclination: Vertical**

**Azimuth:**

Depth	Drilling Method	Casing	Ground Profile		Samples		Additional Lab Tests/Notes	Piezometer Installation
			Description	Graphic Log	Depth/Elev	Type Recovery		
			Ground Surface		0.00			
			<b>TOPSOIL</b> Brown SILT (TOPSOIL), moist, soft, slightly plastic.					
			<b>SAND</b> Light brown very fine SAND, some coarse white Gravel, moist, "medium dense", non plastic. 2cm thick colour change to orange, then as above		0.45	A 100		
1			<b>SAND</b> Brown medium SAND, some Silt, trace fine Gravel, moist, "medium dense", non plastic.		1.00	A 100		
			<b>Silty SAND</b> Brown Silty fine SAND, wet-saturated, "medium dense", non plastic.		1.40			
2			<b>SAND</b> Grey very fine SAND, some Silt, dry-moist, "medium dense", non plastic.		2.00	A 73		
			<b>SAND</b> Grey medium-coarse SAND, some fine pumice Gravel, wet, "loose", non plastic.		2.56	A 100		
3								
			<b>SAND</b> Dark grey fine SAND, moist, "medium dense", non plastic.		3.50			
			<b>SAND</b> Grey medium-coarse SAND, some fine pumice Gravel, wet, "loose", non plastic.		3.70			
4			<b>SAND</b> Grey medium SAND, some coarse pumice Sand, moist-wet, "medium dense", non plastic.		4.10	A 100		
			<b>SILT</b> Brown organic SILT, moist, firm, slightly plastic.		4.30			
			<b>PEAT</b> Dark brown PEAT, wet, soft, slightly plastic-non plastic.		4.40			
			<b>SILT</b> Brown SILT, moist, soft-firm, slightly plastic.		4.50	A 100		
			<b>SAND</b> Grey pumiceous medium to coarse SAND, "loose", saturated, non plastic.		4.90			
5			Becoming fine SAND					
			End of Log		5.00			
6								

**Remarks:**

PT=Push tube

SPT=Standard Penetration Test

**Logged: S Amore**

**Date: 28/06/06**

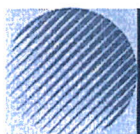
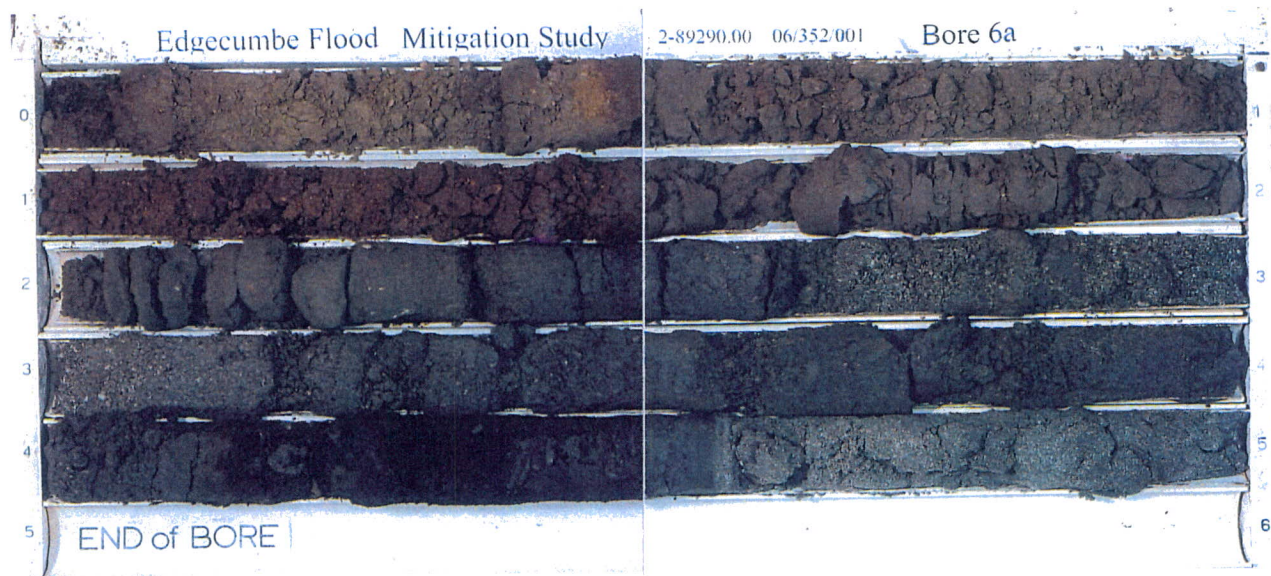
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**Drill Rig: Perry Drilling - Tractor Rig**

**Start Date: 28/06/06**

**Finish Date: 28/06/06**

**Scale:**



**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH6a



Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

Page: 1 of 1

Borehole No: 6b

Project Name: Edgcombe Flood Mitigation Study  
Client: Environment Bay of Plenty  
Location: Edgcombe  
Project No. 2-89290.00 Lab Ref. 06/352/001

Co-ordinates:

Grid:

Elevation: Not Established

Datum:

Inclination: Vertical

Azimuth:

Ground Profile				Samples		Additional Lab Tests/Notes	Piezometer Installation
Depth	Drilling Method	Description	Graphic Log	Depth/Elev	Type		
	Casing						
		Ground Surface					
0		<b>TOPSOIL</b> Brown SILT (TOPSOIL), saturated, soft, slightly plastic, some roots.		0.00			
		<b>SAND</b> Grey medium-coarse SAND, wet, "loose", non plastic.		0.22	A	93	
		<b>SILT</b> Brown SILT, wet, soft, slightly plastic.		0.42			
		<b>Sandy SILT</b> Dark grey very fine Sandy SILT, moist, soft, slightly plastic.					
		<b>SILT</b> Brown SILT, wet, soft, slightly plastic.					
1		<b>Sandy SILT</b> Dark grey very fine Sandy SILT, some fine-medium Gravels and orange white clay/silt intrusions, moist, soft, slightly plastic.		1.00	A	100	
		<b>SAND</b> Grey fine-coarse SAND, some white pumice flecks, saturated, "loose", non plastic.		1.20			
		<b>Organic SILT</b> Brown organic SILT, wet, very soft, slightly plastic.		1.45			
		<b>SILT</b> Brown SILT, some very fine Sand, wet, soft, slightly plastic.			A	80	
2		<b>SAND</b> Grey very fine SAND, "loose", saturated, non plastic.					
		<b>SILT</b> Grey SILT, moist, soft, slightly plastic.		2.50	A	100	
		<b>Organic SILT</b> Brown organic SILT, some sticks, moist, soft, slightly plastic.		2.60			
		<b>SILT</b> Grey brown SILT, moist, firm, slightly plastic.		2.70			
3		<b>Organic SILT</b> Brown organic SILT, some sticks, moist, soft, slightly plastic.		2.80			
		<b>SAND</b> Greyish white fine-medium SAND, saturated, "loose-medium dense", non plastic.		2.90			
		<b>Organic SILT</b> Brown organic SILT, some sticks, moist, soft, slightly plastic.			A	100	
				3.50			
					A	0	
4		End of Log		4.00			
5							
6							

Remarks:

PT=Push tube

SPT=Standard Penetration Test

Logged: S Amore

Date: 28/6/06

Checked:

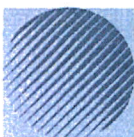
Drill Rig: Perry Drilling - Tractor Rig

Start Date: 28/6/06

Finish Date: 28/6/06

Scale:





**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

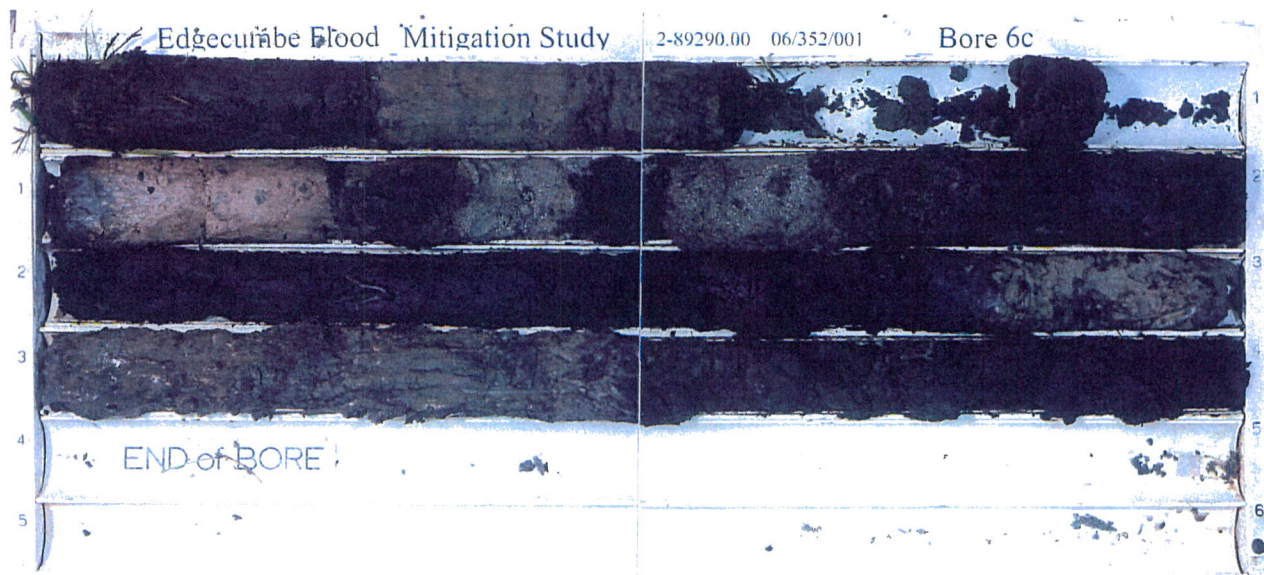
**Borehole Number:** BH6b



Co-ordinates:  
Grid:  
Elevation: Not Established      Datum:  
Inclination: Vertical      Azimuth:

<b>Remarks:</b> PT=Push tube SPT=Standard Penetration Test	<b>Logged:</b> S Amoores <b>Checked:</b>	<b>Date:</b> 28/6/06
	<b>Drill Rig:</b> Perrys Drilling	
	<b>Start Date:</b> 28/6/06	<b>Finish Date:</b> 28/6/06
	<b>Scale:</b>	





**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH6c



Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

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Borehole No: 7a

Project Name: Edgcumbe Flood Mitigation Study  
Client: Environment Bay of Plenty  
Location: Edgcumbe  
Project No. 2-89290.00 Lab Ref. 06/352/001

Co-ordinates:

Grid:

Elevation: Not Established

Datum:

Inclination: Vertical

Azimuth:

Depth	Drilling Method	Casing	Ground Profile		Samples		Additional Lab Tests/Notes	Piezometer Installation
			Description	Graphic Log	Depth/Elev	Type Recovery		
0			Ground Surface					
			<b>TOPSOIL</b> Brown SILT (TOPSOIL), dry-moist, firm, slightly plastic.	x x x x x	0.00			
			<b>SAND</b> Greyish brown orange mottled very fine SAND, trace Silt, dry-moist, "medium dense", non plastic.	x x x x x	0.30	A 93		
1						A 0		
			Becoming brown orange flecked		1.50			
			Becoming greyish brown orange mottled		1.64	A 100		
2								
			No Silt		2.30	A 100		
			<b>Silty SAND</b> Greyish brown orange mottled Silty very fine SAND, dry-moist, "medium dense", non plastic.	x x x x x	2.70			
3			<b>SILT</b> Greyish brown SILT, minor organics, wet, soft, slightly plastic.	x x x x x	2.95			
			Becoming brownish grey.	x x x x x	3.20	A 100		
			<b>Sandy SILT</b> Grey very fine Sandy SILT, wet, firm, slightly plastic-non plastic.	x x x x x	3.38			
			<b>SILT</b> Greyish brown SILT, minor organics, wet, soft, slightly plastic.	x x x x x	3.70			
4			<b>SILT</b> Grey SILT, some coarse pumice Sand and root material, saturated, soft, slightly plastic.	x x x x x	4.00	A 0		
						A 60		
			Wood material diameter of core barrell and 2cm thick	x x x x x	4.90			
5			End of Log		5.00			
6								

Remarks:

PT=Push tube

SPT=Standard Penetration Test

Logged: S Amore

Date: 29/6/06

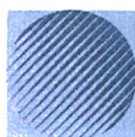
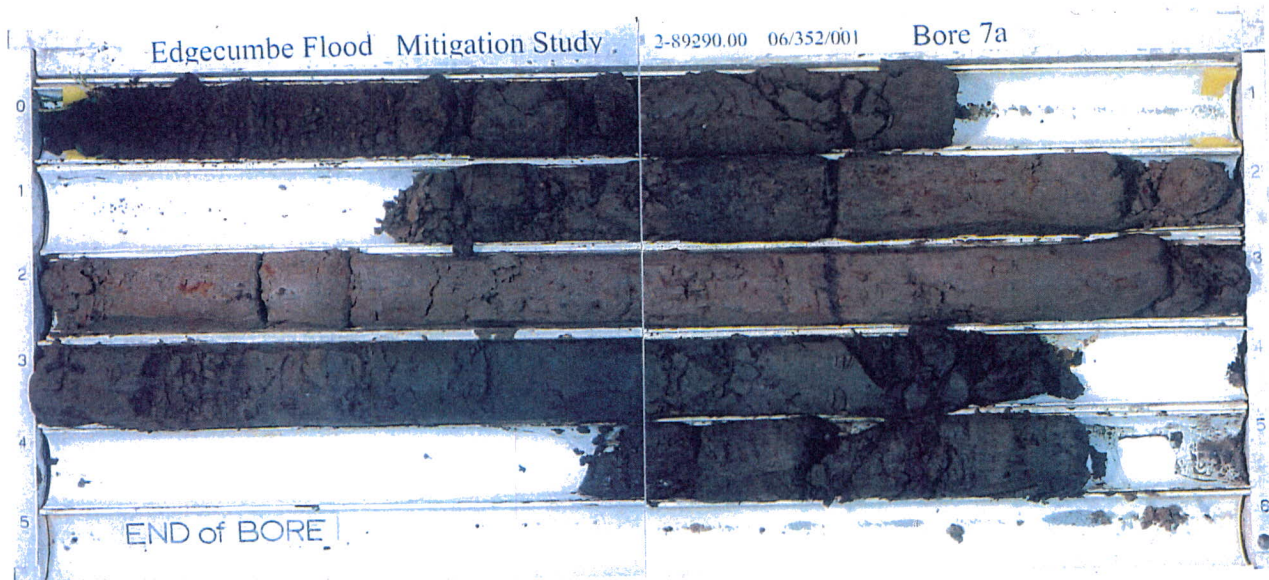
Checked:

Drill Rig: Perry Drilling - Tractor Rig

Start Date: 29/6/06

Finish Date: 29/6/06

Scale:



**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH7a



Hamilton Laboratory  
Private Bag 3057  
Hamilton  
New Zealand  
Tel. 64 7 856 2870  
Fax 64 7 856 2873

OPUS

Page: 1 of 1

Borehole No: 7b

Project Name: Edgecumbe Flood Mitigation Study  
Client: Environment Bay of Plenty  
Location: Edgecumbe  
Project No. 2-89290.00 Lab Ref. 06/352/001

Co-ordinates:  
Grid:  
Elevation: Not Established Datum:  
Inclination: Vertical Azimuth:

Depth	Drilling Method	Casing	Ground Profile			Samples		Additional Lab Tests/Notes	Piezometer Installation
			Description	Graphic Log	Depth/Elev	Type	Recovery		
			Ground Surface						
0			<b>TOPSOIL</b> Brown SILT (TOPSOIL), moist, soft-firm, slightly plastic.		0.00				
			<b>SILT</b> Brown orange mottled SILT, trace coarse SAND, moist, soft, slightly plastic.		0.30	A	67		
			<b>SILT</b> Dark brown SILT, trace coarse Sand, and orange mottles, wet, soft, slightly plastic.		0.55				
			<b>SAND</b> Brown medium-coarse SAND, saturated, "loose", non plastic.						
			<b>SILT</b> Greyish brown orange mottled SILT, moist, soft, slightly plastic.			A	100		
			<b>PEAT</b> Dark brown PEAT, fibrous, wet, very soft, slightly plastic-non plastic.		1.20				
			<b>Sandy SILT</b> Grey very fine Sandy SILT, moist, firm, slightly plastic.		1.50				
			<b>PEAT</b> Dark brown PEAT, fibrous, wet, very soft, slightly plastic-non plastic.		1.60				
			<b>PEAT</b> Dark brown PEAT, fibrous, wet, very soft, slightly plastic-non plastic.		1.80	A	100		
			<b>SILT</b> Light brown SILT, moist-wet, soft, slightly plastic.		1.95				
			<b>SAND</b> Light greyish white medium SAND, wet, "medium dense", non plastic.		2.25				
			<b>PEAT</b> Dark brown PEAT, fibrous, wet, very soft, slightly plastic-non plastic.			A	100		
			<b>SAND</b> Light greyish white medium SAND, wet, "medium dense", non plastic.						
			<b>PEAT</b> Dark brown PEAT, fibrous, saturated, very soft, slightly plastic-non plastic.		2.85				
			<b>SILT</b> Grey SILT, trace very fine Sand and fine-coarse pumice Gravels, wet-saturated, soft-firm, slightly plastic.		2.95				
			<b>SAND</b> Grey fine SAND, some fine-coarse pumice Gravel, wet, "medium dense", non plastic.		3.40	A	100		
			<b>PEAT</b> Dark brown PEAT, wet, very soft, slightly plastic.		3.80	A	100		
4			End of Log		4.00				
5									
6									

Remarks:

PT=Push tube

SPT=Standard Penetration Test

Logged: S Amore

Date: 29/6/06

Checked:

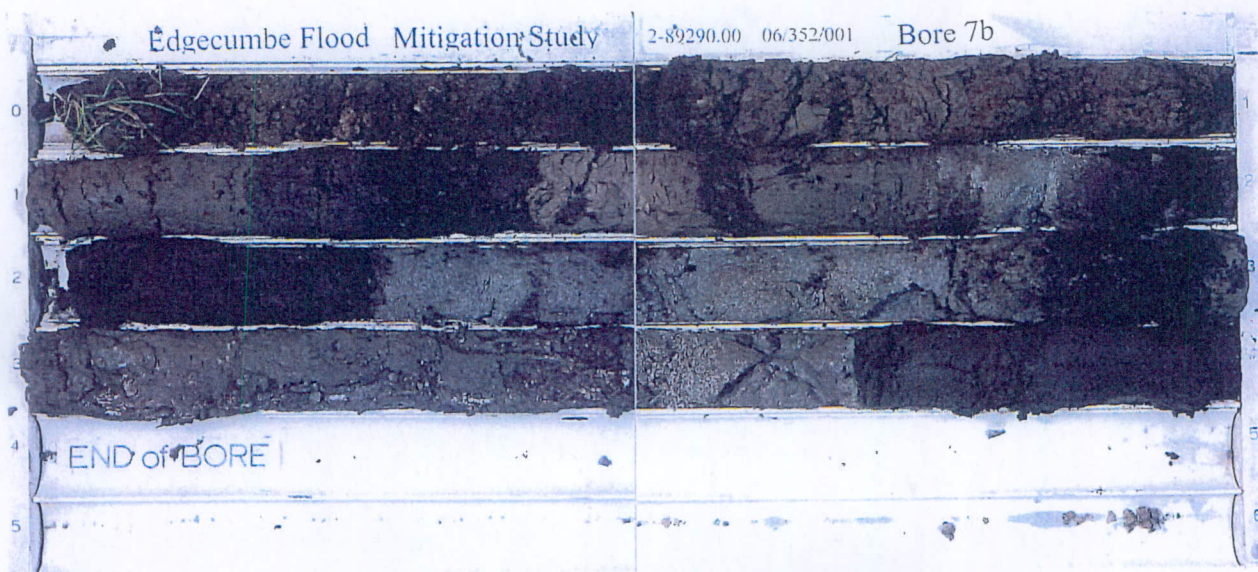
Drill Rig: Perry Drilling - Tractor Rig

Start Date: 29/6/06

Finish Date: 29/6/06

Scale:





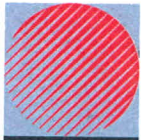
**OPUS**

**Client:** Environment Bay of Plenty

**Project:** Edgecumbe Flood Mitigation Study

**Project number:** 2-89290.00

**Borehole Number:** BH7b



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