



HUTT RIVER ESTUARY BRIDGE

**Sediment extraction from the Hutt River Mouth
and foundation stability of Estuary Bridge**




Prepared for Greater Wellington

HUTT RIVER ESTUARY BRIDGE

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Prepared by


Franciscus (Kos) Maas
Senior Hydraulic Engineer

Opus International Consultants Limited
Environmental
Level 9, Majestic Centre, 100 Willis Street
PO Box 12 003, Wellington 6144,
New Zealand

Reviewed by


Grant Webby
Principal Hydraulic Engineer

Telephone: +64 4 471 7000
Facsimile: +64 4 499 3699

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1 Introduction

The Hutt River has a catchment of 640km² (Figure 1.1). A number of tributaries contribute water and sediment to the main channel as it flows in a south-westerly direction towards the river mouth in Wellington Harbour. It should be noted that sediment movement down the river is episodic, and predominantly occurs under flood conditions. The rate of sediment transport increases non-linearly with the flow of the river.

The Hutt River mouth has been transformed considerably since 1900; from a coastal estuary to a well-defined river channel. The channel has been straightened and the bed excavated for flood management purposes. The Estuary Bridge is located approximately 600m upstream from the mouth of the Hutt River. The extraction of sediment from the Hutt River mouth can have a significant influence on the bed level in the vicinity of the bridge. Other factors that influence the bed level at this location are the supply of sediment from upstream, the bridge, and the scour protection placed around three of the four piers.

The impact of sediment extraction on bed levels near the Estuary Bridge was assessed by examining changes in cross-sections both upstream and downstream of the bridge. The study reach is 1327m long and extends between cross-sections 30 and 160. This reach extends 730m upstream and 600m downstream of the bridge.

Resource consent conditions do not currently place a limit on the extraction of sediment in close proximity to the bridge. To minimise any risk and potential damage to the foundations and rip-rap aprons round the bridge piers it is recommended that conditions be imposed to limit the extraction of sediment near the bridge.

All Reduced Levels (RL) in this report are in terms of Lower Hutt City New Datum (mean sea level). This is equivalent to Wellington City Datum (mean sea level) and Mean Sea Level Wellington 1953.

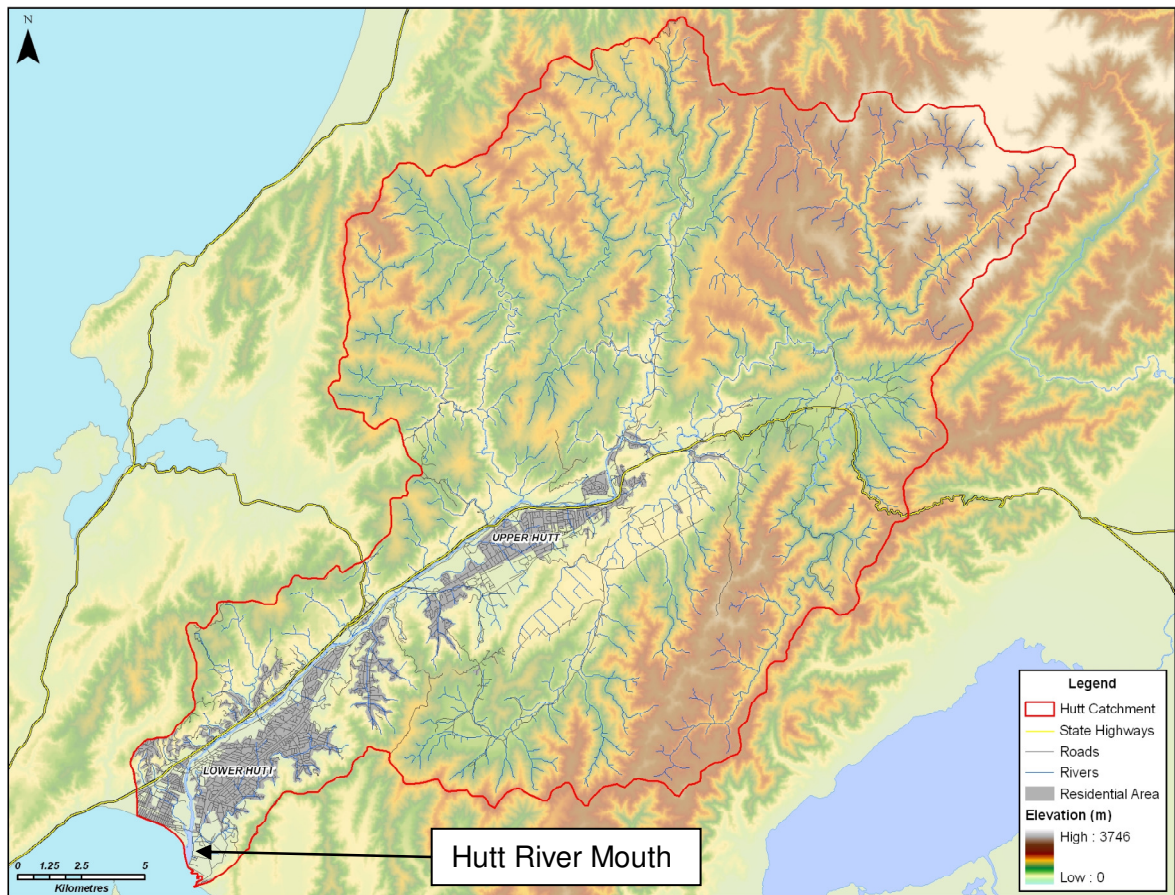


Figure 1.1: Hutt River catchment.

2 Available data

2.1 Cross-section survey data

The Greater Wellington Regional Council (GWRC) regularly surveys cross-sections at 313 locations along the lower 33.5km of the Hutt River. The data from these surveys are used to analyse trends in bed-material movement, and bed aggradation and degradation along the river. The results of these analyses are used to guide policy on gravel extraction and general river management.

The last five surveys were carried out in 1987, 1993, 1998, 2004 and 2009. Given the number of river cross-sections to be surveyed, each survey took a number of months to complete. Table 2.1 notes the period of each survey that has been assumed for the analysis in this report.

Table 2.1: Assumed survey dates.

Survey year	Survey period	Assumed survey end date
1987-1989	May-September 1987 (mouth to Silverstream Bridges) October to December 1988 (Silverstream Bridges to Birchville Gorge) August to September 1989 (Birchville Gorge to Hutt Gorge)	1 Sept1987
1993	April-August 1993	1 August 1993
1998	January-April 1998	1 April 1998
2004	December 2003-April 2004	1 April 2004
2009	September 2008-April 2009	1 April 2009

Cross-section 30 is coincident with the end of Winstone Aggregates Ltd sand mining plant located on the right bank of the river mouth (refer to aerial photographs in Appendix A). Cross-section 1 is coincident with the end of the Seaview reclamation on the left bank of the Hutt River mouth. Sediment deposition occurs over the reach between these cross-sections and some of this material is actively mined by Winstones.

2.2 Gravel extraction data

Over time large quantities of sediment have been extracted from the Hutt River mouth, and at various locations further upstream. GWRC has recorded the quantities of sediment extracted from specific reaches of the Hutt River (refer to gravel extraction volume table in Appendix B). For the purposes of this analysis, it has been assumed that the extraction within each reach is approximately uniform along the length of that reach.

2.3 Bridge construction and scour protection details

In 1998 Hutt City placed rock rip-rap scour protection aprons around three of the four piers of the Estuary Bridge (Hutt City Council, 1998). Drawings detail the existing foundations of the bridge and the scour protection. Copies of the relevant drawings have been included in Appendix C.

3 Impact of sediment extraction

3.1 Sediment extraction

Data obtained from GWRC (refer Table 3.1 and Figure 3.1) show that between 1987 and 2009 sediment was extracted at the river mouth and upstream of cross-section 210 (situated at the Ava Rail Bridge). Extraction has therefore occurred well upstream of the Estuary Bridge. The annualised sediment extraction returns have been adjusted to match the periods between cross-section surveys.

It should be noted that the sediment material extracted upstream of cross-section 210 is predominantly gravel. That extracted at the river mouth is predominantly sand and silt.

The sediment extraction volumes from the river mouth include all material extracted between Winstone's sand mining plant and the end of the Seaview reclamation. The extraction of this material has been predominantly well downstream of the Estuary Bridge.

The data in Table 3.1 and Figure 3.1 show that extraction volumes from the river mouth have been relatively constant. However, the extraction volumes upstream of the river mouth have varied both in amount and in location. Between 1992 and 2000 the extraction of gravel material from the river upstream of the mouth was suspended to allow the bed to recover. In the 2004-2009 inter-survey period the extraction volume upstream of the river mouth increased significantly.

Table 3.1: Sediment extraction volumes from the Hutt River between 1987 and 2009.

Inter-survey Period	Extraction Volumes in Reaches (m ³)						Total
	River Mouth	90-210	210-320	320-660	660-800	800-980	
1 Sep 1987- 31 Jul 1993	279,255		32,331		27,955		342,298
1 Aug 1993 – 31 Mar 1998	220,205						220,205
1 Apr 1998 – 31 Mar 2004	263,213			46,656			309,869
1 Apr 2004 – 31 Mar 2009	220,132			226,042			446,174
1 Sep 1987-31 Mar 2009	982,805			332,983			1,318,546

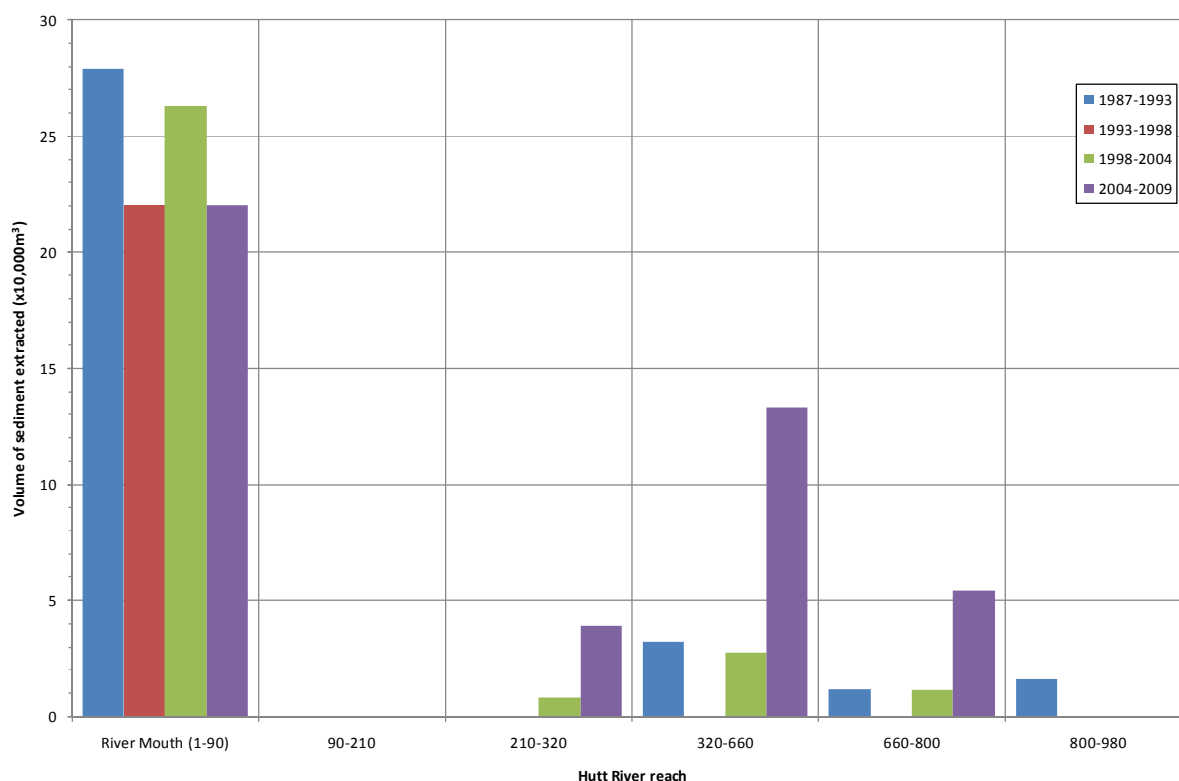


Figure 3.1: Sediment extraction volumes from Hutt River between 1987 and 2009.

3.2 Impact on the river bed

Each of the cross-sections examined for this study (cross-sections 30-160) has varied considerably over time (refer Appendix D). No clear trend over the entire reach can be deduced from the analysis of individual cross-sections.

One way to analyse the trends reflected in the cross-sections is to look at the *minimum* bed level on each cross-section. From Figure 3.2 it can be seen that in the last inter-survey period the bed appears to have aggraded upstream of the bridge. No such clear distinction can be made relating to the channel downstream of the bridge. The bed downstream of the bridge, however, has remained above the sediment extraction level limit. The variability shown in the cross-sections could be because of the extraction of sediment in the river mouth varying in location over time. Over the first 300m downstream of the bridge the bed level appears to be below the top of the rock rip-rap aprons round the piers. These reduced bed levels are, however, localised and do not compromise the stability of the bridge. While these low bed levels do not represent an immediate cause for concern, this situation should be considered when setting conditions on any new resource consent relating to sediment extraction from the river mouth.

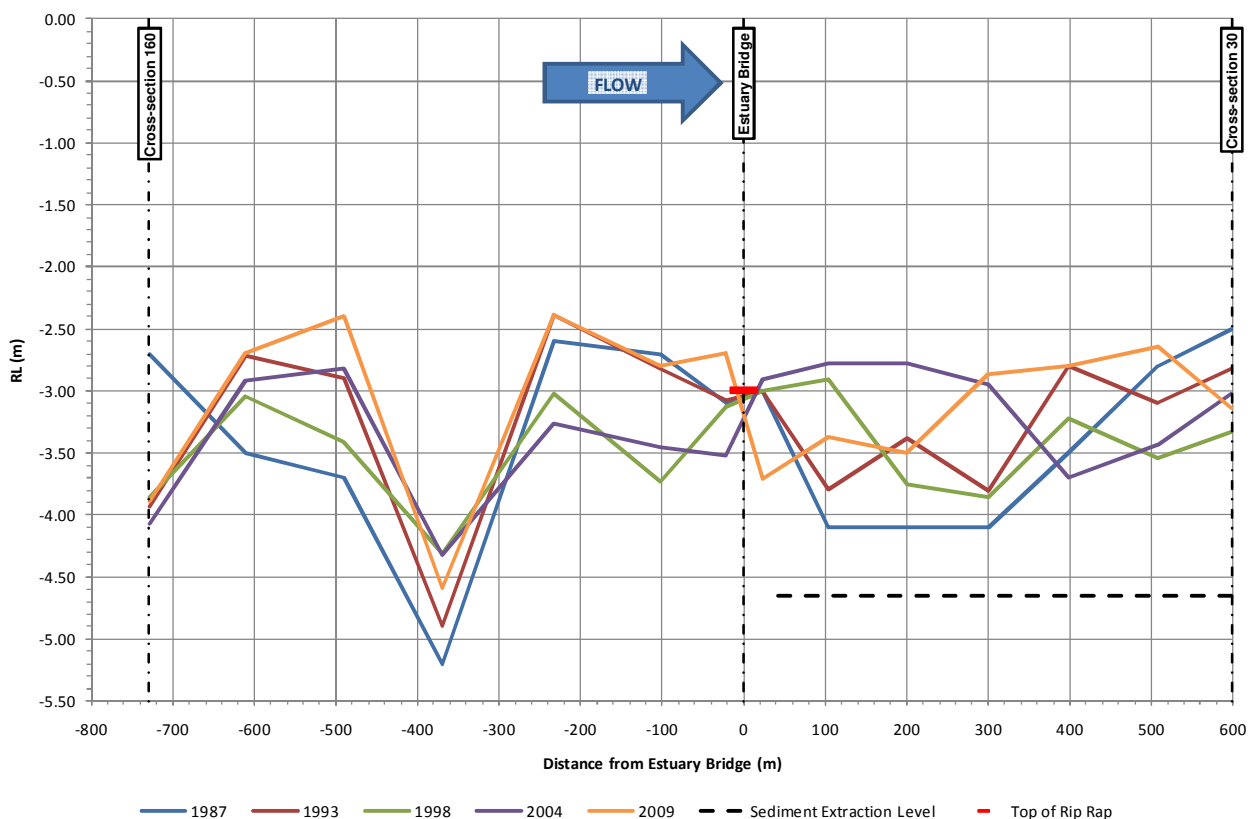


Figure 3.2 Variation in minimum bed level between 1987 and 2009.

A better way to assess changes in the cross-sections over time, and with respect to each other, is by comparing the mean bed levels. Figure 3.3 shows the variation of the mean bed level along the reach considered. In general, the mean bed level remains above the top of

the rock rip-rap and the sediment extraction level. Furthermore, the bed of the Hutt River has aggraded since the 2004 survey, except for a reach between 50 and 300m downstream of the bridge. This is most likely as a result of sediment extraction being carried out over this section during that period.

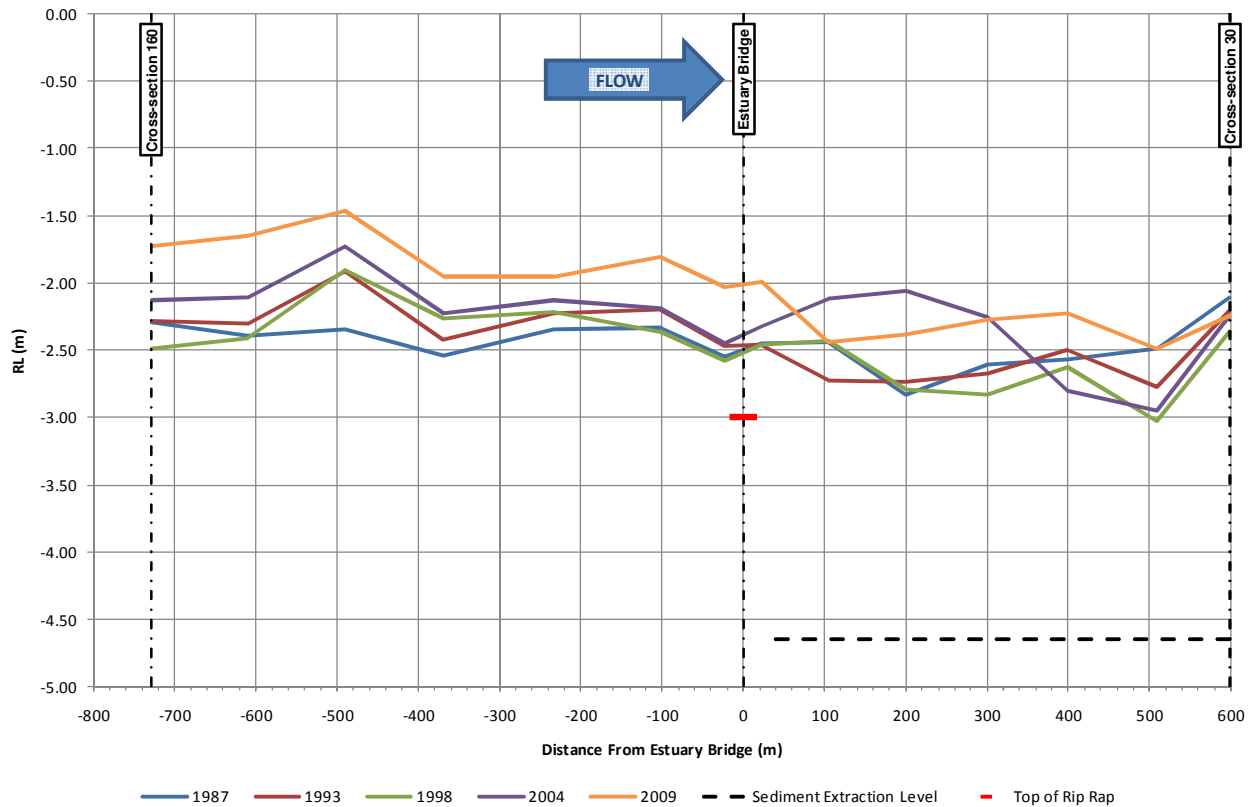


Figure 3.3 Variation in Hutt River mean bed level between 1987 and 2009.

3.3 Impact on Estuary Bridge

The construction drawings of the bridge (Hutt City Council, 1998) show that Piers 1, 2 and 4 have been provided with a rip-rap apron with a top level at RL -3.0m. Each of the aprons extends up to 18.15m downstream of the centre-line of the bridge. The drawings also show that the foundation of each of the piers extends to well below the sediment extraction limit of RL -4.65m. The shallowest foundations are those of Piers 3 and 4 at RL -8.84m

Cross-sections 90 and 100, being the cross-sections immediately downstream and upstream of the bridge, can be examined to provide greater detail regarding variation in the level of the river bed near the Estuary Bridge. Both cross-sections are approximately 22.5m from the bridge centre-line and are consequently close to the edges of the rock rip-rap. Both show some minor aggradation in the last inter-survey period; between 2004 and 2009. The bed on both cross-sections is above the sediment extraction level limit, and in most places above the top of the rip rap aprons. The only place of concern appears to be the depth of the invert in cross-section 90 on the west side of the bridge. This area is below the top of the rock rip rap aprons.

Resource consent conditions do not currently place a limit on the extraction of sediment in close proximity to the bridge. The present consent conditions theoretically permit a vertical-sided pit to be excavated in the bed next to the bridge. Such a pit could have significant unforeseen and unpredicted consequences. If the excavation pit sloped upstream and got progressively shallower, this would minimise any potential adverse effects on sediment transport and bed form.

To minimise any risk and potential damage to the foundations and rip-rap aprons round the bridge piers it is recommended that conditions therefore be imposed to limit the extraction of sediment near the bridge.

The following conditions limiting the extraction of sediment near Estuary Bridge might be appropriate:

- No sediment extraction shall occur within 25m of the downstream end of the piers of the Estuary Bridge.
- Extraction of sediment from 25 to 50m downstream of the Estuary Bridge piers shall not reduce the river bed level by more than would result from a gradual slope between the following levels:

Distance downstream from the Estuary Bridge piers (m)	RL (m)
25	-3.00
50	-4.65

- The sediment extraction at distances in excess of 50m of the downstream end of the piers of the Estuary Bridge shall not occur at any level deeper than RL -4.65m.

4 Conclusions

The Hutt River upstream of the Estuary Bridge is aggrading. The majority of sediment extracted from the lower Hutt River is removed from the river mouth, downstream of the Estuary Bridge. Sediment extraction has not endangered the foundations or rock rip-rap aprons round the piers. No specific conditions limiting sediment extraction with respect to the bridge are included in the current resource consent. To ensure that the foundations of the Estuary Bridge are not compromised in future, it is recommended that new conditions be included in any future resource consent.

5 Recommendations

To protect the foundations and rock rip-rap aprons round the piers the following conditions could be included in future resource consents:

- No sediment extraction shall occur within 25m of the downstream end of the piers of the Estuary Bridge.
- Extraction of sediment from 25 to 50m downstream of the Estuary Bridge piers shall not reduce the river bed level by more than would result from a gradual slope between the following levels:

Distance downstream from the Estuary Bridge piers (m)	RL (m)
25	-3.00
50	-4.65

- The sediment extraction at distances in excess of 50m of the downstream end of the piers of the Estuary Bridge shall not occur at any level deeper than RL -4.65m.

6 References

- Gardner, M. 2010: *Hutt River floodplain management plan – Hutt River Gravel Analysis 1987 -2009*, Greater Wellington Regional Council Report, Reference N/03/09/05, June 2010.
- Hutt City Council, 1998: *Hutt estuary bridge scour protection, Contract No. AD 16-2746, Contract Documents*. December 1998.
- Opus, 2010a: *Hutt River Mouth: Fluvial sediment transport*. Report prepared for Greater Wellington Regional Council by Opus International Consultants Ltd. Reference 350861.00, September 2010.
- Opus, 2010b: *Hutt River Mouth: Coastal sediment transport processes and beach dynamics*. Report prepared for Greater Wellington Regional Council by Opus International Consultants Ltd. Reference 350861.00, September 2010.
- Opus, 2010c: *Hutt River Mouth: Sediment Input and Aggradation in the lower Hutt River*. Report prepared for Greater Wellington Regional Council by Opus International Consultants Ltd. Reference 350861.00, October 2010.

**Appendix A – Aerial photographs showing cross-sections along
the Hutt River in the vicinity of the Estuary Bridge**

(Source: Gardner, 2010)



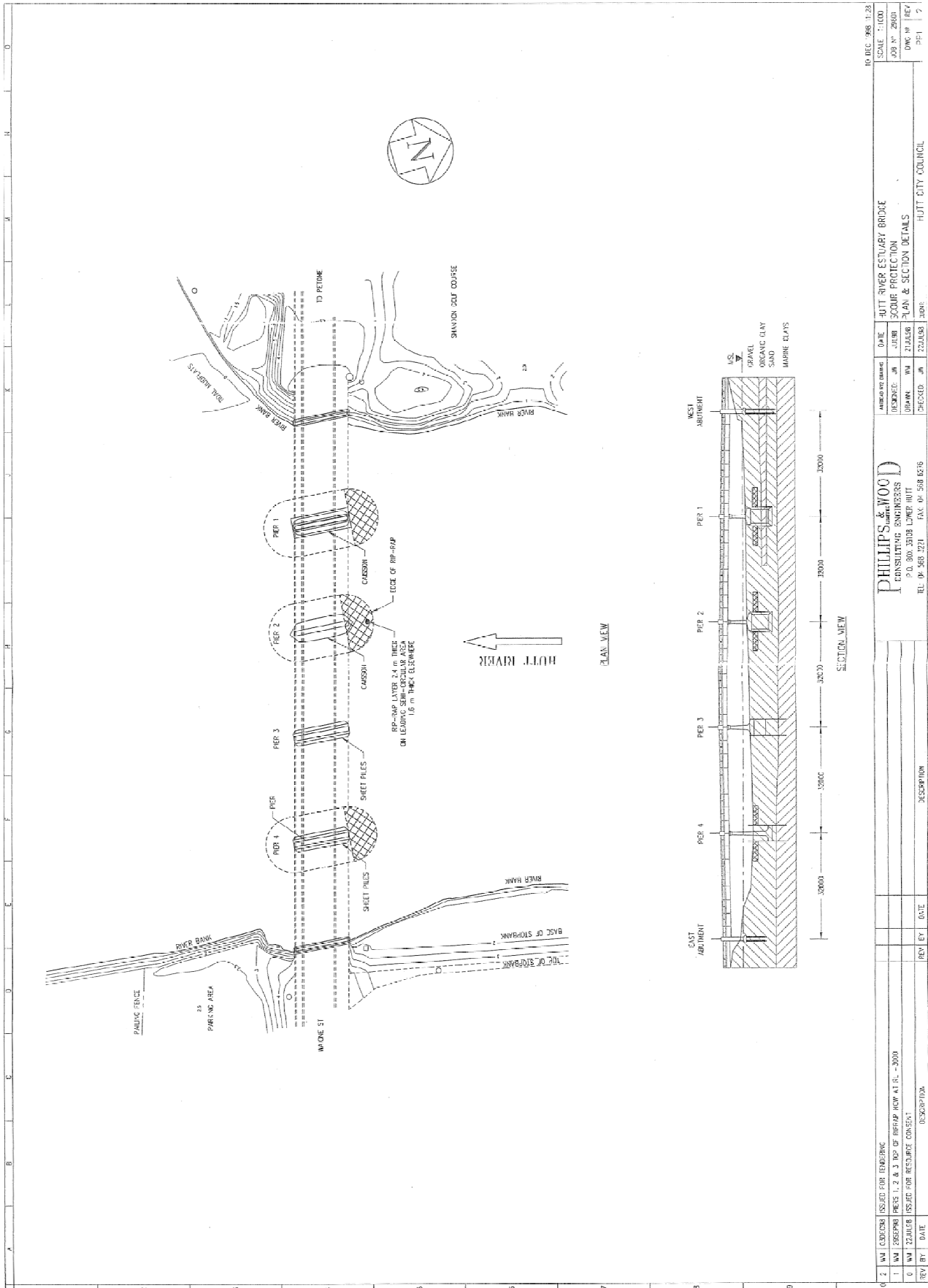
Appendix B – Sediment extraction volumes from the Hutt River

Year	Extraction Volumes in Reaches (m ³)					
	River Mouth	210-320	320-660	660-800	800-1010	Total
1987	37,000	15,122				52,122
1988	46,000	10,631				56,631
1989	51,000	16,659				67,659
1990	54,000	13,84		24,328		78,342
1991	61,000			6,384		67,384
1992	27,000					27,000
1993	48,000					48,000
1994	48,000					48,000
1995	51,968					51,968
1996	37,688					37,688
1997	48,069					48,069
1998	58,387					58,387
1999	41,966					41,966
2000	45,374					45,374
2001	41,664	13,186				54,850
2002	39,816	15,823				55,639
2003	39,102	16,462				55,564
2004	45,486	4,752				50,238
2005	51,240	58,545				109,785
2006	44,734	37,642				82,376
2007	39,445	59,604				99,049
2008	41,650	63,171				104,821
2009	36,064	14,207				50,271

(Source: GWRC records)

**Appendix C – Drawings of Hutt River Estuary Bridge including
scour protection works**

(Courtesy Hutt City Council)

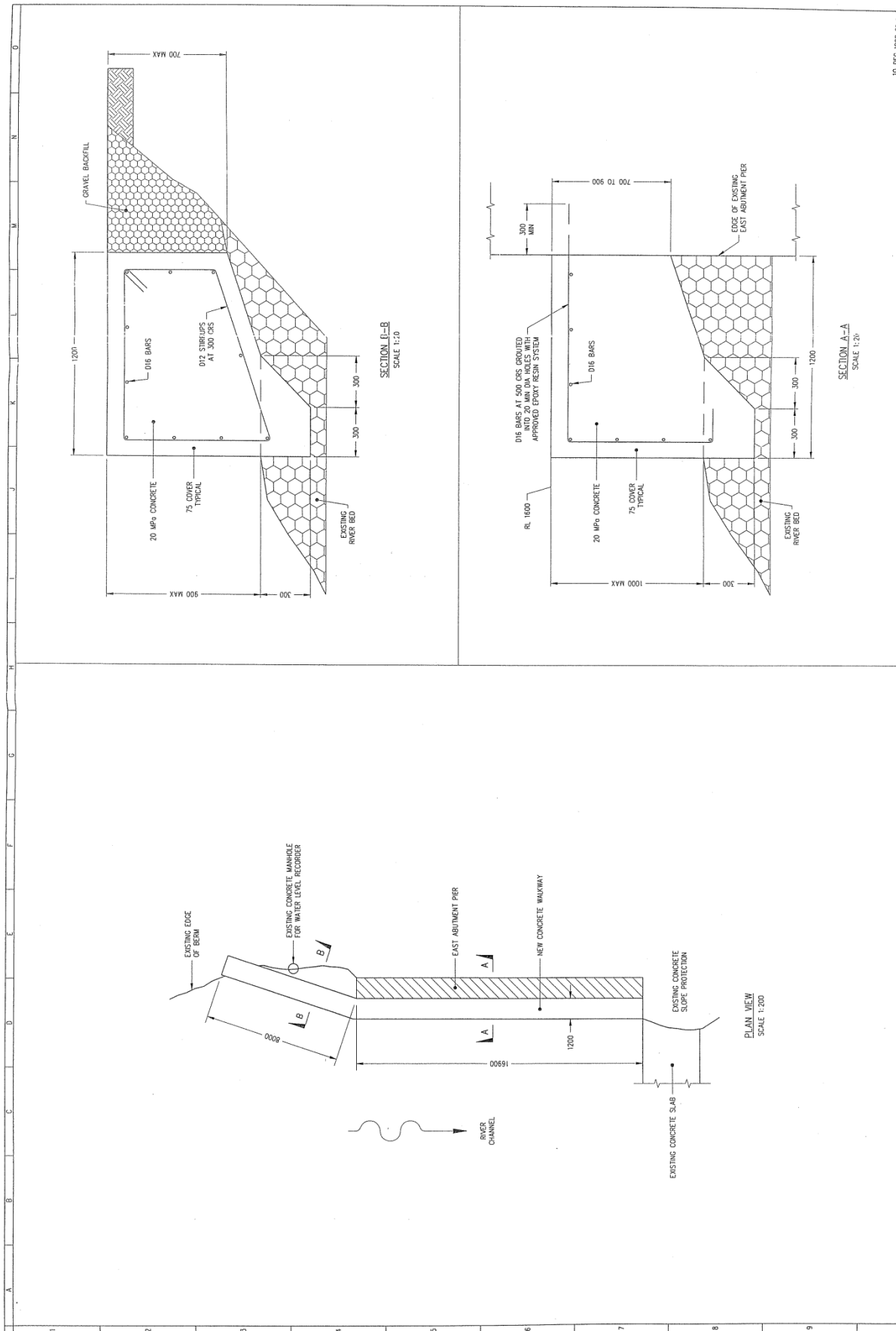


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P01 2

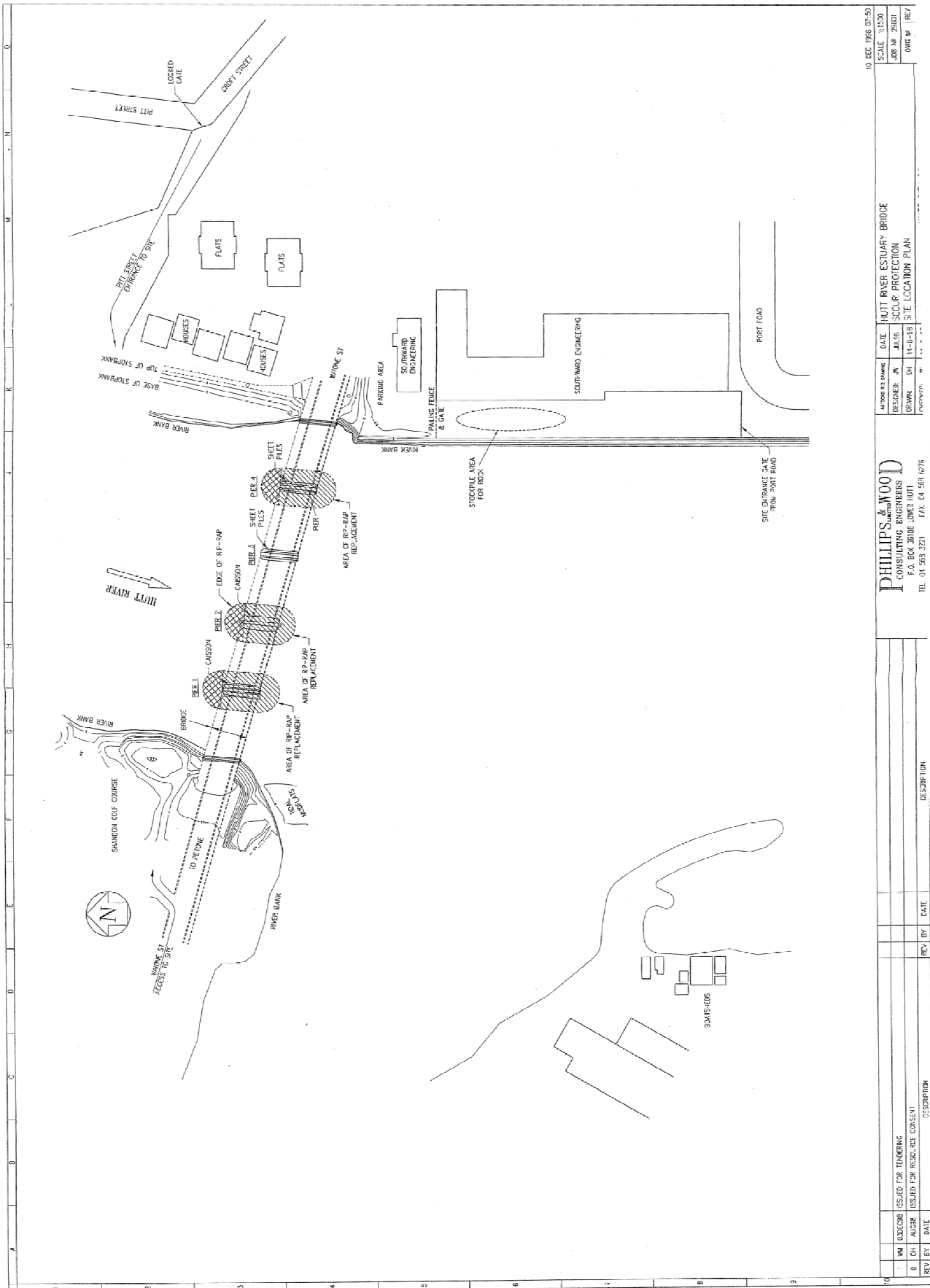
DATE: HUTT RIVER ESTUARY BRIDGE
DESIGNED BY: JIMMY SCOUR PROTECTION
DRAWN BY: JIMMY SCOUR PROTECTION
CHECKED BY: JIMMY SCOUR PROTECTION
HUTT CITY COUNCIL

PHILLIPS & WOOD
CONSULTING ENGINEERS
P.O. BOX 3208 LOWER HUTT
TEL: 04 568 7271 FAX: 04 568 8276

REV	BY	DATE	DESCRIPTION
02	WA	22/04/08	ISSUED FOR TENDERING
01	WA	08/05/08	PIERS 1, 2 & 3 TOP OF RIP-RAP NOW AT RL -2000
00	WA	22/04/08	ISSUED FOR RESOURCE CONSENT

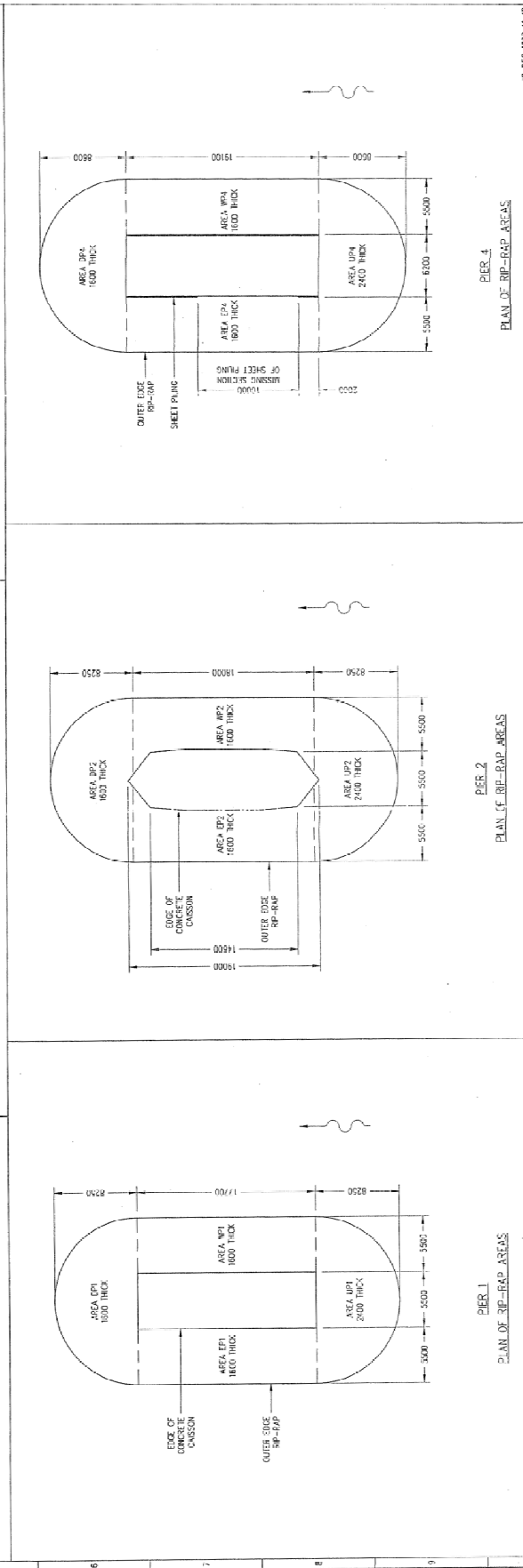
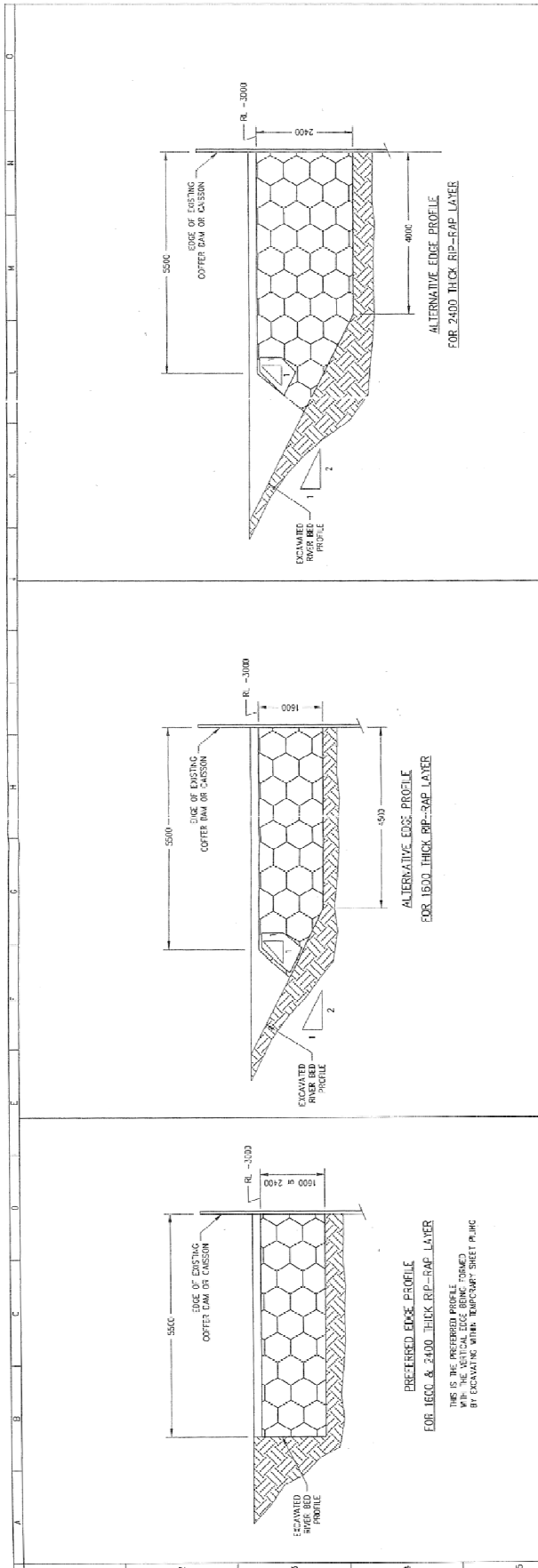


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REV 1		DRAWN: JW		EAST ABUTMENT CONCRETE WALKWAY			
PPS		CHECKED: JW		HUTT CITY COUNCIL			
		10DEC98		LEFT			
PHILLIPS & WOOD CONSULTING ENGINEERS P.O. BOX 36108 LOWER HUTT TEL: 04 588 3321 FAX: 04 588 6276							
REV	BY	DATE	DESCRIPTION	REV	BY	DATE	DESCRIPTION
0	JW	10DEC98	ISSUED FOR TENDERING				



10 DEC 1988 07:50	DATE	10 DEC 1988 07:50	SCALE	1:500
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CONSULTING ENGINEERS	DRAWN BY	PHILLIPS & WOOD	DATE	11-8-83
P.O. BOX 3000 LIVERMOUTH	PROJECT	PITTS RIVER ESTUARY BRIDGE		
TEL: 01 563 3211 FAX: 01 561 6776	DESCRIPTION	SCOUR PROTECTION		
		SITE LOCATION PLAN		
		DWG NO. 1/27		

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1	WJ	04/08/08	ISSUED FOR TENDERING
0	CH	14/08/08	ISSUED FOR RESUBMITTAL



NO.	REV.	DATE	DESCRIPTION
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	REV	BY	DATE
	REV	BY	DATE
	REV	BY	DATE

DATE	11/11/09	DATE	11/11/09
DESIGNED BY	JW	CHECKED BY	JW
DRAWN BY	AW	DATE	08/05/10

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SCALE	1:100
PROJECT NO.	10003
DATE	11/11/09
DESIGNED BY	JW
DRAWN BY	AW
CHECKED BY	JW
DATE	08/05/10

PHILLIPS & WOOD CONSULTING ENGINEERS
 P.O. BOX 3148 LOMES HUTT
 TEL: 04 546 3221 FAX: 04 546 6276



Appendix D – Hutt River cross-sections 30 to 160

(Based on data provided by GWRC)

