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SALT WEDGE TRACING IN THE OUTER BRISBANE RIVER ESTUARY

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Prepared For:
Port of Brisbane Authority

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Job No: 3795

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PORT OF BRISBANE AUTHORITY: SALT WEDGE TRACING AND SUSPENDED LOAD IN THE OUTER BRISBANE RIVER ESTUARY

1.0 BACKGROUND

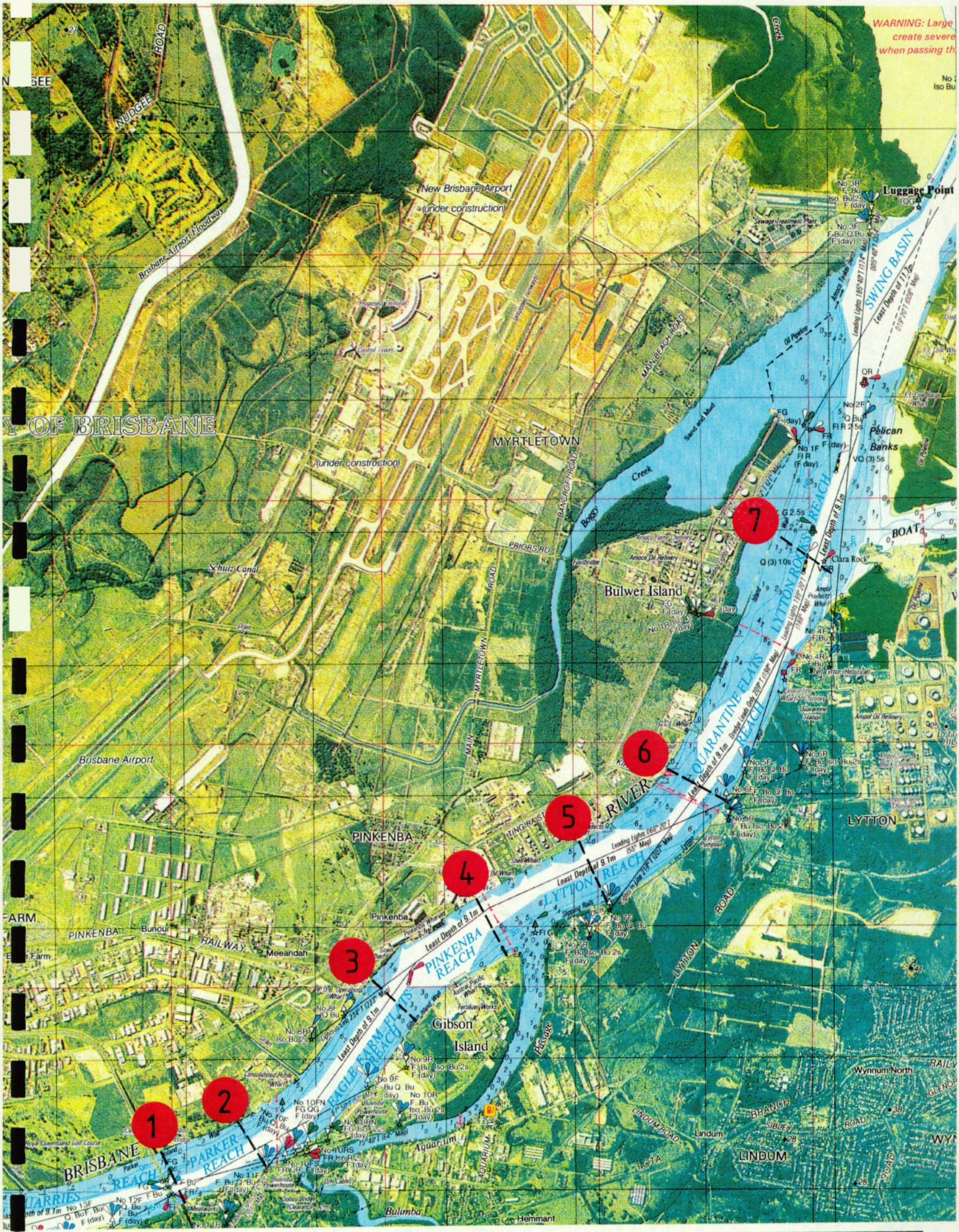
Brisbane River drains a catchment of approximately 1,200 km^2 and enters Moreton Bay, a semi-enclosed shallow embayment created by the barrier sand islands of North Stradbroke and Moreton Islands. An extensive port complex has been developed in the outer Brisbane River estuary catering for a wide range of coastal and international shipping. Maintenance of adequate channel draft for the port requires consistent dredging due to the accumulation of silt transported from the catchment. This material comes out of suspension on mixing with the saline waters of the estuary. Widespread mobilisation of unconsolidated bed material also occurs during flood events.

This report covers a sampling programme undertaken on behalf of the Port of Brisbane Authority on the 6th and 7th of April 1988 during a period of significant but relatively minor discharge in the river equivalent to a flood flow of 50% probability of annual exceedance caused by 7 days of persistent antecedant rainfall in the catchment.

The intent of the sampling programme was to locate the upstream penetration of a tidally driven salt wedge underlying the outflowing fresh water and to monitor changes to salinity and suspended load over the duration of at least half of a complete tidal cycle. Locations are illustrated in Figure 1.

2.0 EQUIPMENT UTILISED IN THE MONITORING PROGRAMME

Depth measurements were initially made using a remote echo-sounder transducer mounted on a weighted fish fabricated from aluminium alloy provided by the Port of Brisbane Authority. This device was connected to an echo-sounder in the 5.5m work boat by a cable and



FIGURE

LOCATION OF CROSS-SECTIONS

1

supported by a rope. Other connections attached to the rope included a cable from a salinity probe attached to the fish, a similar cable to a submersible optical transparency meter and a 13mm diameter reinforced hose through which water samples were drawn via a pump mounted in the boat. Transect profiles of the channel were taken using a chart recording echo-sounder.

3.0 DETAILS OF THE MONITORING PROGRAMME

Measurements commenced on the rising tide during the morning of Wednesday, 5th April. The salinity meter was used to locate the toe of the salt wedge, which involved a longitudinal traverse of the river over about 2-3 hours. Salinity mesurements and sediment sampling were carried out at that time.

During late morning there was some delay in loading the transparency meter of the Cameron McNamara which had been air-freighted from North Queensland.

Problems were encountered at the re-commencement of measurements during early afternoon with the falling tide. Strong currents (>0.8 m/s) were generated by the combined outgoing tide and flood discharge, and the echo-sounder/instrument fish could not be made to set correctly in the flow. Difficulties were also experienced with the salinometer, which ultimately became inoperable. A replacement was hired from the Department of Harbours and Marine.

By late Wednesday afternoon, with the tide at about slack low, all equipment was again functioning. The toe of the salt wedge was again located and a series of measurements taken until monitoring ceased at 7.15pm.

Measurements re-commenced on Thursday (7th April). The salt wedge was relocated at 6.50am and monitored through the rising tide to high water and into the start of the ebb. Monitoring ceased at approximately 2.30pm.

It was found necessary to take mesurements with the boat held under motor power in a semi-drifting mode. This minimised cable streaming. The P.O.B.A. fish was later disconnected and depths determined by a lead weight on a calibrated shot line.

4.0 RESULTS OF THE MONITORING PROGRAMME

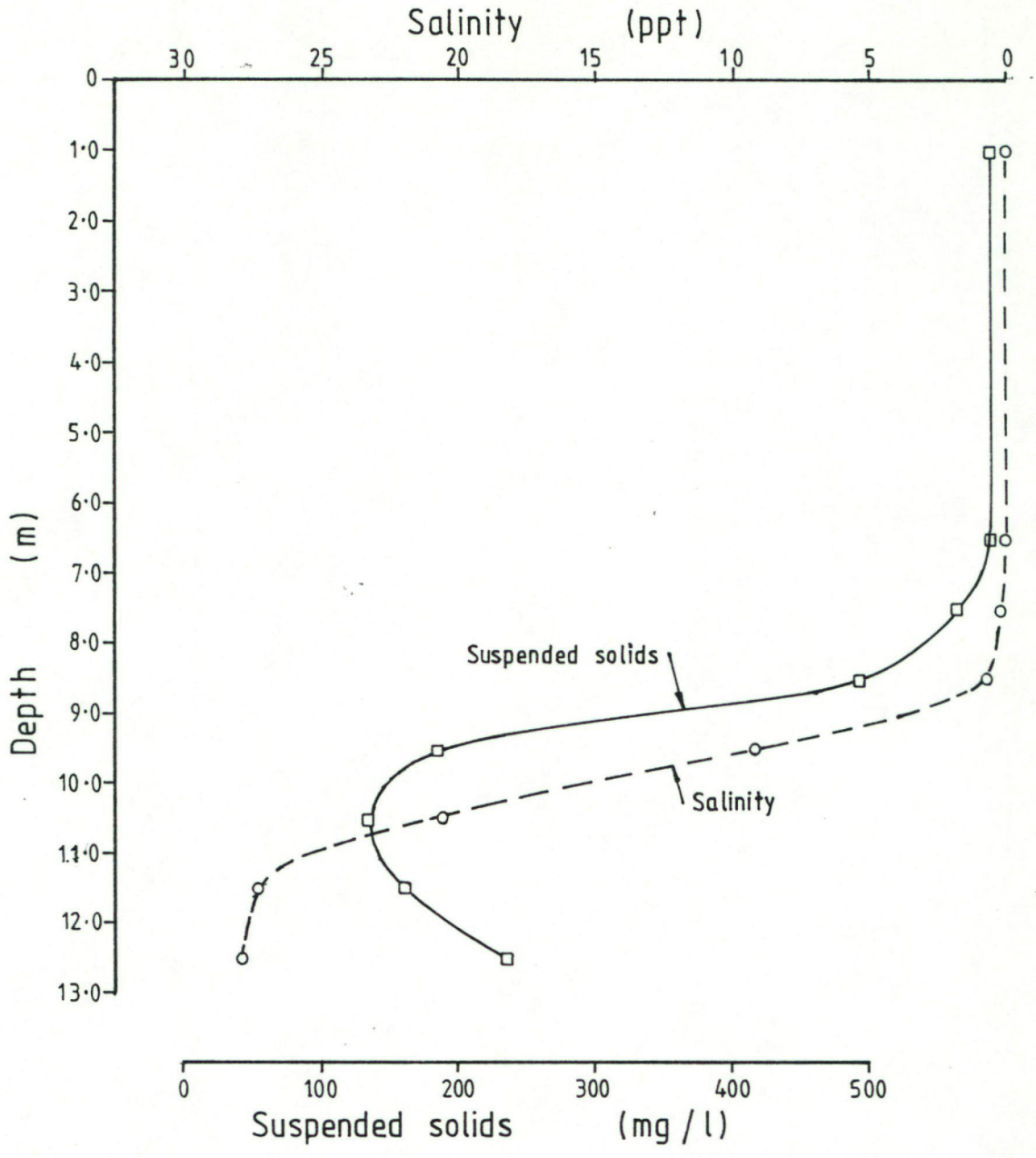
4.1 GENERAL CHARACTERISTICS OF THE SALT WEDGE

Measurements of the temperature, salinity and optical properties of the water column clearly defined a pronounced salt wedge in the lower estuary whose upstream limit within the estuary appeared to vary only slightly over a tidal cycle but whose thickness showed major changes. The wedge was typified by greatly improved water clarity over the interface between fresh and salt water and this is illustrated in a typical vertical profile taken at low and high water near the upstream limit of the wedge. (See Figure 2)

Further downstream the thickness of the wedge increased and counter current upstream movement of the probes and shot line was noted near the peak of the tide, indicating a strong flood tide underlay the outflowing surface water.

4.2 CHARACTERISTICS OF THE SALT WEDGE AT DIFFERENT LOCATIONS IN THE ESTUARY

A series of cross-sectional measurements were taken at the extreme upstream limit of the wedge and at points downstream of this during various tidal states. These cross-sectional records (see Appendix) indicate that the salt wedge was confined to the floor of the channel and, at its upstream limit, did not extend over the full width of the cutting. The interface between incoming saltwater and outflowing floodwaters was particularly well defined with salinity changes from fresh to salt occurring generally over the 1 to 1.5 metres in vertical height. This separation was noticeably narrower



(TRANSECT 3, SITE B, 1305 hrs on 7-4-88)

FIGURE 2

TYPICAL SALINITY AND SUSPENDED SOLIDS CONCENTRATION PROFILE.

at the upstream limit and became broader at the most downstream cross-section, suggesting some mixing at the interface occured near the river mouth. All data is listed in the Appendix.

A discussion of the relative changes to the wedge dimensions and characteristics over time at monitored locations appears below.

Transect 1. Upstream limit of monitoring, 100 metres downstream the Gateway Bridge.
This transect was measured in the late morning of 7.4.88 (11am) after earlier measurements downstream. Salinity levels were zero at all depths - i.e. freshwater conditions prevailed. This was taken as being beyond the tidal influence. Earlier readings taken on the evening of 6.4.88 showed similar characteristics indicating the salt wedge did not penetrate to this part of the river.

Transect 2. Opposite Bulimba Power Station.
Initially measured at 6.50am on 7.4.88 and at later stages during the day. When first monitored the salt wedge was most noticeable on the northern side of the channel being approximately 1.5m deep on the bottom thinning to 1 metre deep at the centre and absent on the southern side. Later in the morning (10.35am), on remeasuring, the wedge had thinned to 0.5m on the northern side and was absent in the centre and southern side. At 1.35pm a slight wedge 1 metre deep had re-established in the centre. By 2.15pm this had started to contract again with noticeably lower salinity at the same depth (12 - 12.5m) compared to that at the peak of tidal inflow.

Transect 3. Opposite Harbours and Marine Wharf.
Initially measured at 8.25am on 7.4.88, this location had a well developed salt wedge of approximately 1 metre deep with a transition zone of very brackish water to freshwater 2 metres from the bottom. Sediment loading showed a marked increase with onset of freshwater conditions in the profile. When remeasured at 1.00pm the brackish interface occurred over a wider range of depths and the main part of the wedge expanded in depth by approximately 1

metre. As the channel was relatively narrow, only two profiles were taken and both had similar characteristics at equivalent depths indicating the salt wedge was relatively uniform across the floor of the channel.

Transect 4. On the Pinkenba Reach opposite ACF/Shirleys Wharf and upstream edge of Aquarium Passage.
The bed of channel was slightly shallower than at Transect 3 (12m vs 12.5m) and salt wedge only well developed in centre with 0.5m thickness. Negligible development on edges of channel in 11m of water. Water noticeably less transparent in wedge than for upstream (deeper, saltier) locations.

Transect 5. Opposite Amoco Products Wharf.
Wide and deep swing basin observed on boat echo-sounder transect, located channel as being slightly shallower. Monitored on north and south sides of channel with salt wedge varying in thickness across river being 1 metre thick on south side and 1.5 metre on the northside. Noticeable mixing zone of brackish water 3-4 metres thick overlay the salt wedge.

Transect 6. Opposite the Boat Ramp just upstream of QCL loader. The salt wedge was well developed being 2.5 metres thick across entire channel floor and overlain by a brackish zone of 3-4 metres thick. This was of intermediate to low salinity and high to moderate transparency. These characteristics were comparable to those measured on the previous evening.

Transect 7. Narrow section of main channel opposite green buoy and Tug Harbour on upstream side of Boat Passage.
There was noticeable reverse flow with the flood tide running upstream over a downstream flood flow. From measurements taken (12.20pm, 7.4.88) there was a thick salt wedge to within 6.5 metres of surface (total thickness 8.5m) with highest transparency 3m from the bottom and a brackish zone approximately 2.5 metres deep. Only one profile was taken due to narrowness of channel and thickness of

salt wedge. These results were similar to those of the previous evening (5.50pm, 6.4.88) taken at Fort Lytton 300 metres upstream where thick salt wedge reached to within 9 metres of surface being overlain by brackish zone 3-4 metres thick.

5.0 INTERPRETATION OF MEASUREMENTS

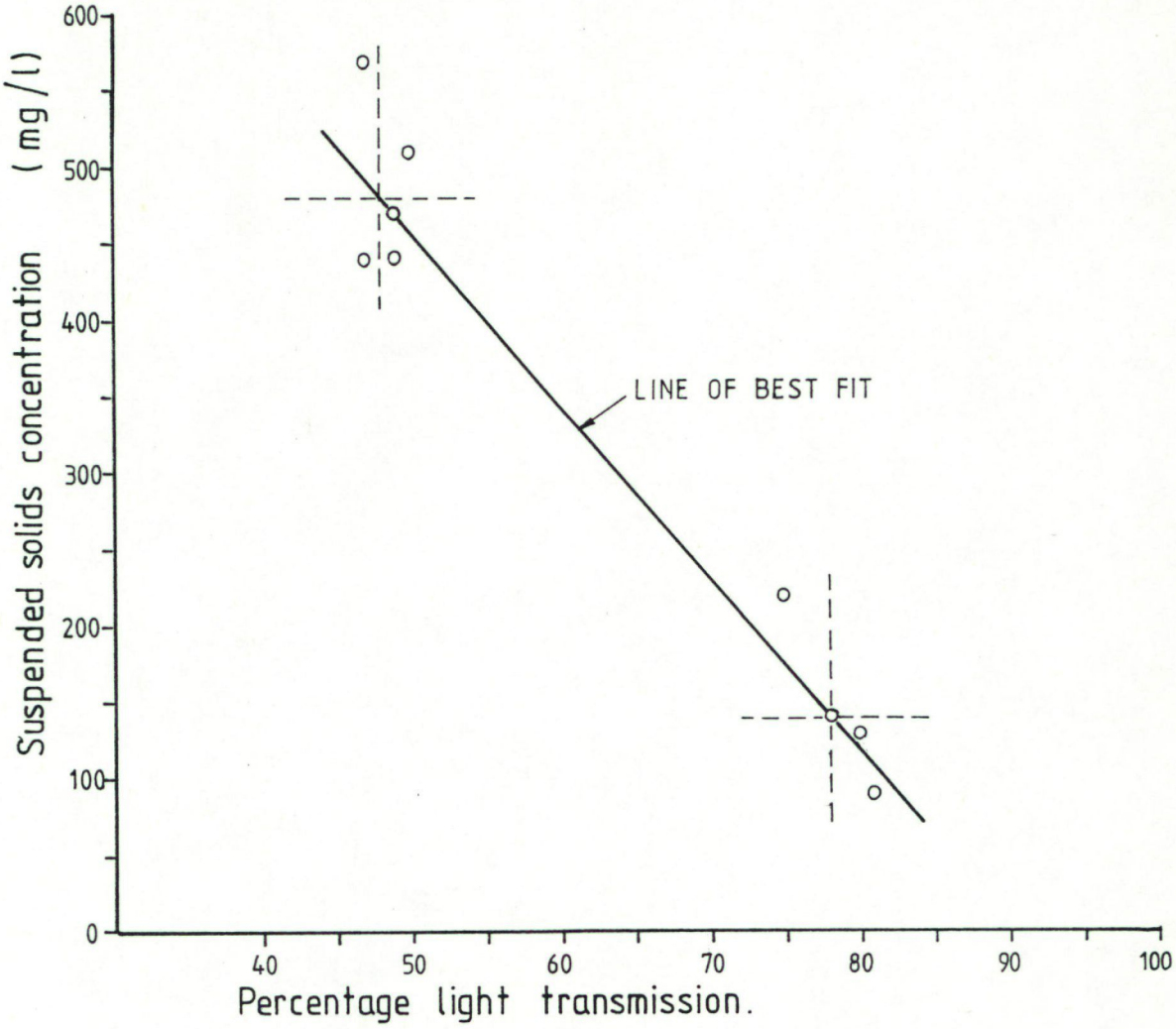
5.1 WATER TRANSPARENCY AND SALINITY RELATIONSHIPS

The full data set of all measurements at various transects at various times appears as an Appendix to this report. Of particular interest was the noticeable relationship between salinity changes and water transparency as measured by the underwater light meter. From check samples taken during the survey then submitted for analysis to Simmonds and Bristow Pty Ltd, a calibration for this meter was obtained. From this, a standard curve of meter reading versus suspended solids calibration was obtained. This calibration data is listed below in Table 1 and graphed in Figure 3.

TABLE 1: CALLIBRATION DATA

Sample Number	Depth (m)	NFR (mg/l)	Light Transmission
3B	1.0	510	50
	8.0	570	47
	12.0	220	75
4C	1.0	470	49
	9.5	130	80
	12.0	140	78
6A	1.0	440	47
	6.0	440	49
	11.5	90	81

Although a general relationship of high salinity = low suspended solids was generally true for all profiles, there are some small but significant exceptions, one of which is illustrated in Figure



CALIBRATION OF LIGHT METER WITH SUSPENDED SOLIDS CONCENTRATION.

FIGURE 3

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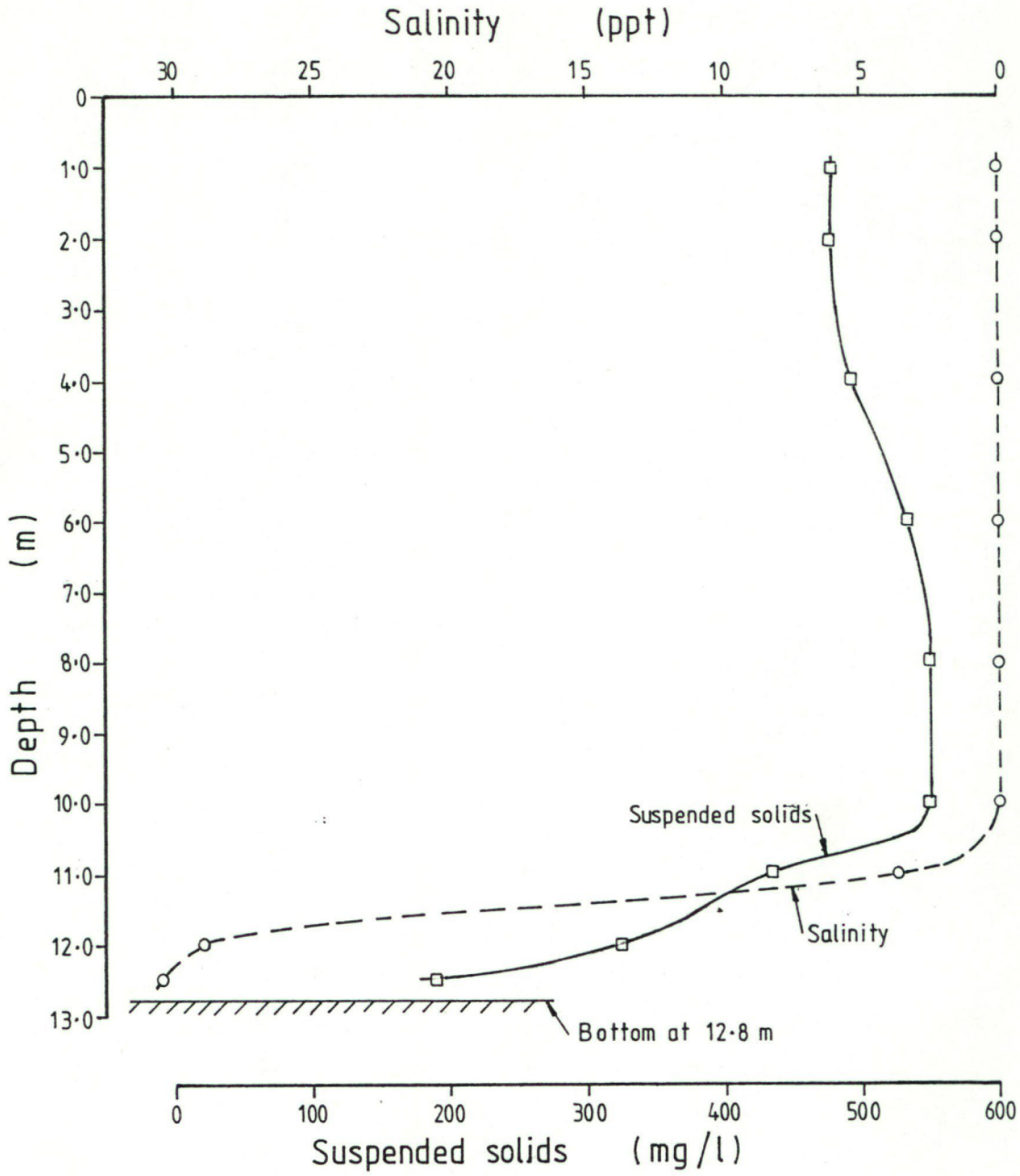

(TRANSECT 2, SITE A, 1650 hrs on 7-4-88)

FIGURE 4

SALINITY AND SUSPENDED SOLIDS PROFILE AT UPSTREAM BOUNDRY.

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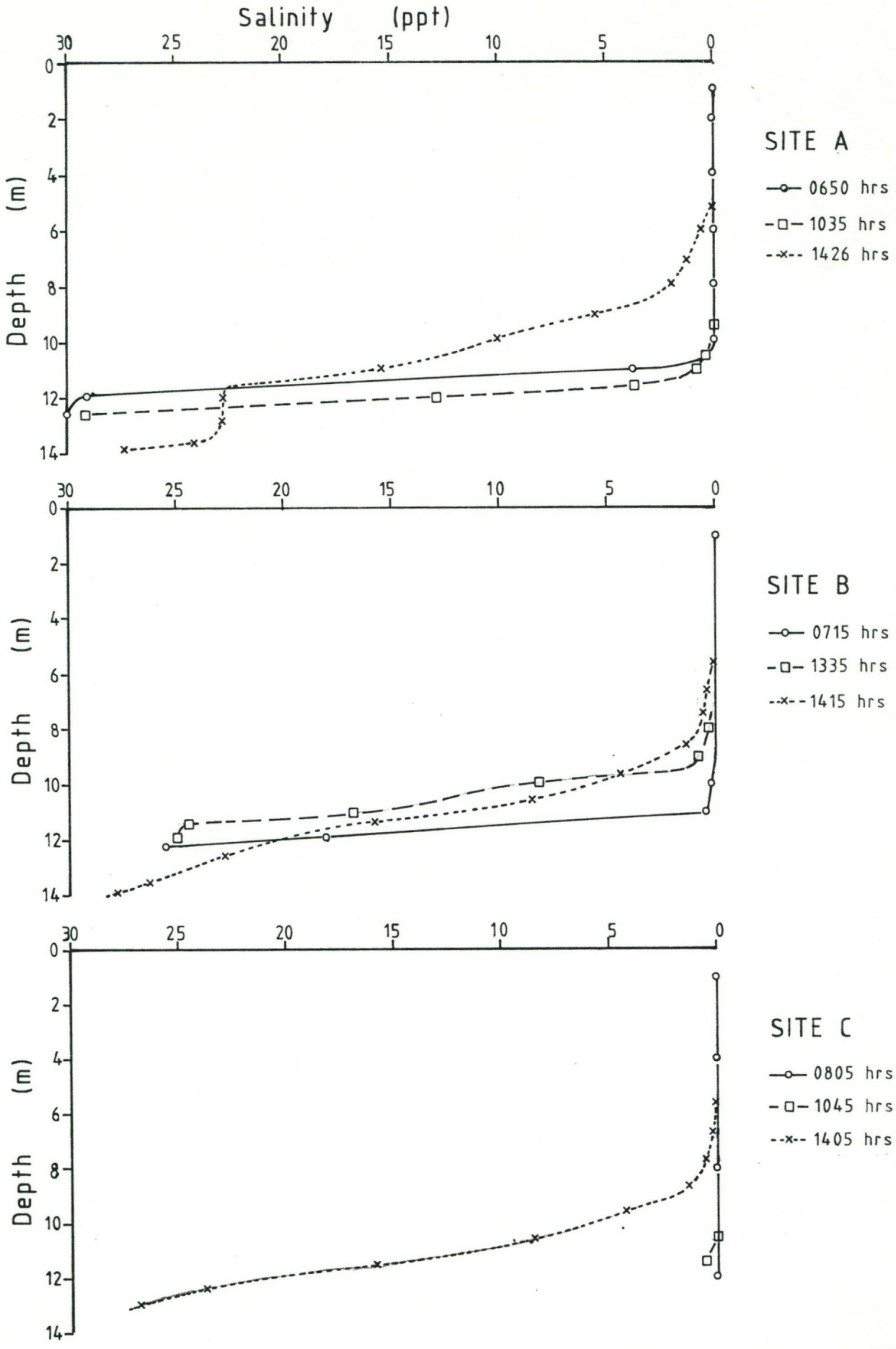
2. This figure shows that nearest the bottom, there is a slight rise in suspended material which declines slightly then rapidly increases across the salt wedge interface. A second exception noticed at Transect 2 on the upstream edge of the wedge, a suspended solids maximum occurred just above the wedge and reduced slightly nearer the surface. An example of this is illustrated in Figure 4. Other sites and transects usually did not show this relationship. The position of Transect 2 on the upstream limit of the salt wedge may be the explanation for this phenomenon, although there was no distinct increase in the concentration of suspended material within the saline part of the wedge below this suspended sediment maxima.

From observations of the lead weight on the shot line, bottom sediments at most locations were very unconsolidated and semi-fluid in texture. Firmer sediments were only encountered at the downstream transect where the greatest thickness of the wedge occurred.

5.2 BEHAVIOUR OF THE SALT WEDGE OVER A TIDAL CYCLE

Of particular interest to this survey was the location of the upstream limit of the salt wedge and monitoring its position over time. To this end, the initial river survey on 6.4.88 located the wedge in the lower estuary between Transects 2 and 3 at 0928 hours. This was confirmed by a full profile of measurements at Transect 3 starting at 1035 hours. It was located again at 1855 hours with the new equuipment at Transect 2: the thickness was probably less than 1 metre. The following morning (7.4.88), it was clearly defined as being at Transect 2 as at Transect 1, 200 metres upstream, freshwater extended to the bottom. The wedge characteristics were followed in detail over the next 7.5 hours. The results of these measurements of the upstream edge of the salt wedge are illustrated in Figure 5.

As illustrated in Figure 5, the most marked change in wedge



TRANSECT 2 ON 7-4-88.

CHANGES IN THE SALT WEDGE AT ITS UPPER LIMIT.

FIGURE 5

characteristics occurred at Transect 2, in that at the lowest part of the tide, the wedge reduced to a thin layer (0.5 - 1m deep) of moderately clear saline water on the northern side of channel, expanded across the whole width on high water but did not advance appreciably upstream, then contracted on the falling tide. The thickness of the wedge steadily increased downstream as the tidal influence increased as did the brackish zone above the wedge. This brackish zone increased in thickness from approximately 0.5m to over 3.5m indicating increasing levels of mixing of the incoming salt water with the outflowing freshwater.

6.0 IMPLICATIONS FOR PORT MAINTENANCE

Based on these measurements, it is difficult to isolate the zone of major sediment deposition other than to suggest it was located at the time of measurement in the downstream reaches between Bulimba Powerstation and Aquarium Passage (Bulimba Creek). Further downstream, the salt wedge was less variable in thickness and of slightly lower solids concentration. Upon reduction of the rate of floodwater discharge, it is anticipated that this zone will progressively move upstream and cause a corresponding shift in the zone of greatest sediment/salt wedge interaction.

APPENDIX: DATA COLLECTED ON 6/4/88 AND 7/4/88 IN THE BRISBANE RIVER

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
1	6/4/88	B	0920	11.5	11.5	-	0.0	0.0	-	-
	7/4/88	A	1058	11.7	11.5	21.6	0.0	0.0	40	586
					10.0	21.6	0.0	0.0	42	562
					8.0	21.7	0.0	0.0	45	527
					1.0	22.0	0.0	0.0	47	503
		B	1100	11.2	11.0	21.7	0.0	0.0	37	621
					10.5	21.7	0.0	0.0	39	598
					9.5	21.7	0.0	0.0	42	562
					8.0	21.6	0.0	0.0	44	539
					6.0	21.6	0.0	0.0	46	515
					1.0	21.8	0.0	0.0	48	491
		C	1103	12.5	12.0	21.7	0.0	0.0	44	539
					11.0	21.7	0.0	0.0	45	527
					8.0	21.7	0.0	0.0	47	503
					1.0	21.8	0.0	0.0	49	480
	7/4/88	B	1315	12.0	11.5	21.8	14.6	9.3	63	314
					11.0	21.9	10.0	6.3	55	409
					10.5	21.9	5.1	3.1	50	468
					9.5	22.0	0.0	0.0	45	527
					1.0	21.7	0.0	0.0	46	515
2	6/4/88	B	1855	12.5	12.0	21.8	32.2	21.0	74	184
					10.0	22.0	0.0	0.0	30	704
					6.0	21.8	0.0	0.0	35	745
	7/4/88	A	0650	12.8	12.5	23.2	44.9	30.5	73	196
					12.0	22.9	42.8	29.0	62	326
					11.0	21.7	6.0	3.7	53	432
					10.0	21.7	0.0	0.0	43	550
					8.0	21.8	0.0	0.0	43	550
					6.0	21.7	0.0	0.0	44	539

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
					4.0	21.6	0.0	0.0	48	491
					2.0	21.6	0.0	0.0	49	480
					1.0	21.6	0.0	0.0	49	480
		B	0715	12.3	12.1	22.9	38.0	25.5	61	338
					12.0	22.9	27.0	18.0	55	409
					11.0	21.6	0.5	0.3	29	716
					10.0	21.6	0.3	0.2	38	610
		C	0805	12.5	no salinity at any depth, no profile taken					
2	7/4/88	A	1035	12.8	12.5	22.9	43.0	29.1	81	102
					12.0	22.1	20.0	12.9	76	161
					11.5	21.9	5.9	3.6	61	338
					11.0	21.9	1.4	0.8	48	491
					10.5	21.7	0.5	0.3	46	515
					9.5	21.8	0.1	0.0	45	527
					8.0	21.8	0.0	0.0	45	527
					1.0	21.8	0.0	0.0	45	527
		C	1045	12.1	11.5	21.7	0.6	0.3	60	350
					10.5	21.8	0.0	0.0	46	515
					1.0	21.7	0.0	0.0	48	491
2	7/4/88	B	1335	12.5	12.0	22.9	37.9	25.4	76	161
					11.5	22.4	26.9	24.4	76	161
					11.0	22.2	25.6	16.8	74	184
					10.0	22.2	13.3	8.1	66	279
					9.0	22.1	1.6	0.9	54	421
					8.0	21.5	0.5	0.2	46	515
					7.0	21.6	0.0	0.0	43	550
					1.0	21.9	0.0	0.0	42	562
2	7/4/88	A	1426	14.5	14.0	22.8	40.2	27.1	78	137
					13.5	22.7	13.3	23.8	78	137
					12.5	22.8	34.0	22.9	78	137
					12.0	22.7	34.1	22.9	78	137

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
					11.0	22.4	23.1	15.3	68	137
					10.0	22.1	15.2	9.8	64	184
					9.0	22.0	8.6	5.5	58	255
					8.0	21.9	2.9	1.9	51	338
					7.0	21.7	1.9	1.2	43	432
					6.0	21.7	0.7	0.5	40	468
					5.0	21.7	0.0	0.0	39	480
					1.0	21.7	0.0	0.0	39	480
		B	1415	14.5	14.0	22.9	41.1	27.7	79	125
					13.5	22.9	38.1	26.2	79	125
					12.5	22.4	33.7	22.7	78	137
					11.5	22.2	24.0	15.7	68	255
					10.5	21.9	13.7	8.5	66	279
					9.5	21.9	6.7	4.2	57	385
					8.5	21.7	1.9	1.2	46	515
					7.5	21.9	0.9	0.5	42	562
					6.5	21.5	0.5	0.3	41	574
					5.5	21.6	0.0	0.0	41	574
					1.0	21.9	0.0	0.0	40	586
		C	1405	13.5	13.0	22.8	40.0	26.8	78	137
					12.5	22.4	35.2	23.7	80	113
					11.5	22.2	24.0	15.7	68	255
					10.5	21.9	13.7	8.5	66	279
					9.5	21.9	6.7	4.2	57	385
					8.5	21.7	1.9	1.2	46	515
					7.5	21.9	0.9	0.5	42	562
					6.5	21.5	0.5	0.3	41	574
					5.5	21.6	0.0	0.0	41	574
					1.0	21.9	0.0	0.0	40	586
3	6/4/88	A	1035	12.0	11.5	23.0	39.0	25.0	-	
					11.0	23.0	36.0	23.0	-	
					8.5	23.0	23.0	14.0	-	

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
					6.5	24.0	0.7	0.4	-	
					4.5	24.0	0.0	0.0	-	
	7/4/88	A	0825	12.5	12.0	22.6	37.4	25.4	75	172
					11.5	22.2	22.4	14.1	75	172
					11.0	22.3	16.8	10.6	74	184
					10.0	21.6	0.6	0.2	50	468
					9.0	21.6	0.7	0.5	48	491
					7.0	21.5	0.0	0.0	47	503
					1.0	21.8	0.0	0.0	49	480
		C	0845	12.8	12.5	22.8	43.3	29.4	84	66
					12.0	22.2	23.2	15.2	80	113
					11.5	22.0	15.0	8.6	77	149
					11.0	21.9	2.8	1.6	72	208
					10.5	21.5	1.6	1.0	52	444
					10.0	21.4	1.2	0.7	51	456
					9.5	21.5	0.1	0.0	49	480
					9.0	21.3	0.0	0.0	49	480
					1.0	21.7	0.0	0.0	48	491
3	7/4/88	A	1300	13.8	13.5	23.0	40.7	27.6	79	125
					13.0	23.0	40.7	27.0	80	113
					12.0	22.7	38.8	26.2	80	113
					11.0	22.7	36.6	24.6	80	113
					10.0	22.2	14.6	9.4	76	161
					9.0	21.9	4.7	2.9	62	326
					8.0	21.9	2.7	1.7	52	444
					7.0	21.6	0.0	0.0	44	539
					1.0	22.1	0.0	0.0	44	539
		B	1305	13.0	12.5	23.0	41.3	27.8	70	232
					11.5	22.8	40.0	26.8	76	161
					10.5	22.5	30.7	20.5	78	137
					9.5	21.9	14.6	9.1	74	184
					8.5	21.8	1.0	0.6	48	491

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
					7.5	21.7	0.8	0.2	46	515
					6.5	21.6	0.0	0.0	44	539
					1.0	22.2	0.0	0.0	44	539
4	6/4/88	B	1845	12.5	12.0	22.7	36.0	24.2	79	125
					10.0	21.7	0.5	0.3	42	562
					6.0	21.8	0.2	0.1	39	598
					2.0	21.7	0.0	0.0	37	621
	7/4/88	A	0905	11.2	11.0	22.1	12.7	8.0	77	149
					10.5	21.9	8.8	5.4	75	172
					10.0	21.8	7.3	4.8	73	196
					9.0	21.8	1.2	0.7	51	456
					8.0	21.8	0.9	0.4	49	480
					7.0	21.7	0.5	0.3	48	491
					6.0	21.8	0.3	0.2	48	491
					1.0	21.8	0.0	0.0	48	491
		B	0915	12.5	12.0	23.0	38.5	25.7	75	172
					11.5	22.0	17.2	11.0	75	172
					11.0	21.9	12.7	7.9	77	149
					10.0	22.2	5.0	3.2	66	279
					9.5	21.8	0.7	0.5	50	468
					8.5	22.0	0.5	0.3	47	503
					8.0	21.8	0.5	0.3	47	503
					1.0	22.0	0.0	0.0	50	468
		C	0935	11.8	11.5	22.2	16.4	10.5	82	90
					11.0	22.0	9.0	5.6	78	137
					10.0	21.7	3.8	2.3	59	361
					9.0	21.8	0.3	0.1	53	432
					8.0	21.8	0.3	0.2	49	480
					7.0	21.8	0.2	0.1	49	480
					6.0	21.8	0.0	0.0	49	480
					1.0	22.0	0.0	0.0	49	480

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
5	6/4/88	B	1815	12.5	12.0	23.1	44.5	30.1	70	231
					10.0	22.5	8.0	5.2	66	279
					8.0	21.8	0.8	0.4	39	598
					6.0	21.7	0.2	0.1	39	598
					4.0	21.8	0.2	0.1	42	562
					2.0	22.1	0.1	0.0	50	468
	7/4/88	A	0945	12.5	12.0	23.2	35.9	30.9	86	42
					11.5	22.6	34.1	22.5	85	54
					11.0	21.9	16.1	10.1	83	78
					10.5	22.3	9.0	5.8	80	113
					10.0	21.6	6.4	4.1	74	184
					9.0	22.0	3.8	2.4	71	220
					8.0	21.8	1.2	0.8	61	338
					7.0	21.4	0.4	0.2	50	468
					6.0	21.5	0.3	0.1	50	468
					5.0	21.4	0.0	0.0	49	480
					1.0	22.2	0.0	0.0	49	480
		C	1018	12.5	12.0	22.8	40.6	27.3	78	137
					11.5	22.9	33.6	22.2	83	78
					11.0	22.6	25.6	16.6	85	54
					10.5	22.1	19.8	12.7	84	66
					9.5	21.9	8.7	5.3	80	113
					8.5	21.7	1.5	0.8	60	350
					7.5	21.4	0.9	0.6	52	444
					6.5	21.8	0.4	0.2	49	480
					5.5	21.5	0.3	0.1	49	480
					4.5	21.8	0.0	0.0	49	480
					1.0	21.7	0.0	0.0	49	480
6	6/4/88	B	1710	12.5	12.0	22.1	28.0	19.0	-	
					10.0	23.0	22.3	14.5	-	
					8.0	22.5	3.7	6.5	-	
					6.0	21.8	1.3	0.7	-	

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
					4.0	21.8	1.4	0.8	-	
					2.0	22.0	1.4	0.8	-	
	6/4/88	B	1800	13.5	13.0	23.2	46.5	31.7	-	
					12.0	22.8	45.7	31.4	77	149
					10.0	22.5	24.0	15.5	79	125
					8.0	21.7	3.9	2.3	55	409
					6.0	21.9	1.3	0.7	45	527
					4.0	21.7	0.4	0.2	43	550
					2.0	21.8	0.4	0.2	43	550
	7/4/88	A	1135	12.5	12.0	23.1	43.8	29.6	79	125
					11.5	23.0	43.8	30.0	81	102
					10.0	22.7	33.3	22.1	82	90
					9.0	22.1	21.6	13.9	83	78
					8.0	22.0	10.4	6.7	81	102
					7.0	21.9	2.9	1.8	64	302
					6.0	21.7	0.8	0.5	49	480
					5.0	21.6	0.5	0.2	48	491
					4.0	21.4	0.0	0.0	46	515
					1.0	21.8	0.0	0.0	47	503
	7/4/88	B	1150	11.8	11.5	23.2	45.2	31.0	75	172
					11.0	22.8	42.2	28.8	80	113
					10.5	22.8	39.0	26.0	81	102
					9.5	22.1	29.1	19.1	81	102
					8.5	22.4	15.7	10.1	81	102
					7.5	22.1	2.2	1.2	58	373
					6.5	21.9	0.5	0.2	47	503
					5.5	21.4	0.0	0.0	44	539
					1.0	22.1	0.0	0.0	47	503
	7/4/88	C	1200	11.0	10.5	23.1	42.3	28.8	81	102
					10.0	22.3	35.3	23.7	82	90
					9.5	22.4	29.9	19.5	82	90
					9.0	22.3	23.7	15.2	81	102

Transect No.	Date	Site*	Time	Bottom Depth	Depth	Temp.	Cond.	Sal.	Light	NFR**
					8.0	22.1	7.6	4.6	69	243
					7.0	21.8	0.8	0.3	51	456
					6.0	21.7	0.2	0.1	47	503
					5.0	21.9	0.0	0.0	46	515
					1.0	22.3	0.0	0.0	47	503
7	7/4/88	B	1220	14.5	14.0	23.5	47.9	32.5	77	149
					13.5	23.2	47.9	32.5	75	172
					12.5	23.3	47.8	32.4	79	125
					11.5	23.2	47.7	32.5	80	113
					10.5	23.3	47.3	32.1	82	90
					9.5	23.1	46.2	31.3	82	92
					8.5	22.9	42.2	28.5	81	102
					7.5	22.9	38.1	25.6	75	172
					6.5	22.3	24.0	15.7	71	220
					5.5	22.1	22.5	7.3	67	267
					4.5	21.8	4.3	2.6	61	338
					3.5	21.8	1.0	0.6	55	409
					2.5	21.7	0.4	0.3	47	503
					1.0	22.1	0.1	0.0	46	515

* Site locations A = north side of channel
B = centre of channel
C = south side of channel

** NFR (suspended solids) calculated from water transparency reading on a standard curve generated by analysis of selected water samples taken during the programme.

DEPTH SOUNDER TRACES FOR SAMPLE TRANSECTS

NOTE: ALL TRANSECTS TAKEN SOUTH TO NORTH

FIGURE A.1