Appendix 5 – Level 1 Criterion Exceedance Correspondence Register.

No Level 1 Coral Condition Management Trigger Criterion exceedances in Impact Criteria Zone C (L1C Criterion Exceedances) have been attributed to dredging related activities. No reactive turbidity management has therefore been required. Below lists all previously submitted L1C Criterion Exceedance compliance reports and related DEMG advice.

Subject	***Exceedance Number***	***Site***	***Reference Correspondence***		
			To	***From***	***Date(s) and/or WBPL Reference Number(s)***
Exceedance Reported to DEC	L1C-1	CRTS	DEC CEO	Woodside	PLU/GOV/00178; 15/01/2008
Exceedance Reported to DEC	L1C-2	ANGI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-3	CONI	DEC CEO	Woodside	PLU/ GOV/00177; 2/01/2008
Exceedance Reported to DEC	L1C-4	COBN	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-5	ANG2	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-6	GIDI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-7	HAM4	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-8	LANI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-9	HAM4	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-10	CRTS	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-11	CRTS	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-12	HAM3	DEC CEO	Woodside	PLU/GOV/00189; 13/02/2008
Exceedance Reported to DEC	L1C-13	GIDI	DEC CEO	Woodside	PLU/GOV/00199; 7/03/2008
Exceedance Reported to DEC	L1C-14	HAM4	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-15	LANI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-16	ANG2	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-17	ANG3	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-18	ANGI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-19	NELS	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-20	CONI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-21	ANG3	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-22	CRTS	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-23	GIDI	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-24	ANG3	DEC CEO	Woodside	PLU/GOV/00238; 2/05/2008
Exceedance Reported to DEC	L1C-25	ANG3	DEC CEO	Woodside	PLU/GOV/00247; 20/05/2008
Exceedance Reported to DEC	L1C-26	HAM3	DEC CEO	Woodside	PLU/GOV/00249; 26/05/2008
Exceedance Reported to DEC	L1C-27	ANG3	DEC CEO	Woodside	PLU/GOV/00254; 3/06/2008
Exceedance Reported to DEC	L1C-28	ANG3	DEC CEO	Woodside	PLU/GOV/00267;

					25/06/2008
Exceedance Reported to DEC	L1C-29	HAM3	DEC CEO	Woodside	PLU/GOV/00270; 7/07/2008
Exceedance Reported to DEC	L1C-30	HAM3	DEC CEO	Woodside	PLU/GOV/00271; 10/07/2008
Exceedance Reported to DEC	L1C-31	CONI	DEC CEO	Woodside	PLU/GOV/00274; 11/08/2008
DEMG Formal advice regarding Exceedances L1C - 1 to 29	L1C - 1 to 29	-	Woodside and DEC CEO	DEMG	20/08/2008
Exceedance Reported to DEC	L1C-32	NELS	DEC CEO	Woodside	PLU/GOV/00316; 4/11/2008
DEMG formal advice regarding L1C- 30 and 31	L1C - 30 and 31	-	Woodside and DEC CEO	DEMG	14/11/2008
Exceedance Reported to DEC	L1C-33	ANG3	DEC CEO	Woodside	PLU/GOV/00320; 21/11/2008
Exceedance Reported to DEC	L1C-34	NELS	DEC CEO	Woodside	PLU/GOV/00323; 27/11/2008

Note: All L1C exceedances are made available to the DEMG via email distribution and access to Woodside maintained website. Data from telemetered sites is updated daily and data from logged sites is updated fortnightly during dredging activities.

Appendix 6 – Phase 1 Water Quality Monitoring Review (MSA93R53).

PLUTO LNG DEVELOPMENT

WATER QUALITY REVIEW

Report: MSA93R53

Report to:
Woodside Burrup Pty Ltd
240 St. Georges Terrace
Perth WA 6000
Australia

MScience Pty Ltd,
239 Beaufort St, Perth, WA 6003, AUSTRALIA

Document Information

REPORT NO.	MSA93R53
TITLE	PLUTO LNG DEVELOPMENT: WATER QUALITY REVIEW
DATE	7 October, 2008
JOB	MSA93
CLIENT	WOODSIDE BURRUP PTY LTD Contract No. 0C00002273
USAGE	This report provides information on the water quality for use in the assessment of dredging impacts in Mermaid Sound.
PRECIS	Turbidity has been measured both before and during dredging and at sites both close to and far from dredging. This report compares turbidity and turbidity change across these sites.
KEYWORDS	Water quality, management triggers, dredging, coral, turbidity

Version-Date	**Released by**	**Purpose**
V1. 23 Sept 08	DGM	Client Review
V2 1 October 08	DGM	Revised
V3 2 October 08	DGM	Final
V4 7 October 08	DGM	Extracted final
V5 8 October 08	DGM	Extracted final revised

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FIGURES

SUMMARY

The report focuses on the changes in water quality in and around Mermaid Sound since the start of dredging in November 2007.

There are 3 Impact Management Zones relevant to the dredging program and to this review. Zone A is close to dredging and there is an expectation of high turbidity and coral mortality in this zone. Zone B is further from dredging and here there is expected to be some changes in water quality but coral mortality of <10%. Zone C is defined by the boundaries of the proposed Dampier Archipelago Marine Park and no loss of coral is permitted.

There is an extensive program of monitoring within Zone C that includes sites within the Potential Zone of Influence (Impact sites) and others outside the Potential Zone of Influence (Reference sites). Sediment plume modelling defined the Zone of Influence as the area that may be affected by dredging and disposal. In Zone C any exceedence of the Level 1 Management Trigger[1] requires investigation and potentially a change in dredging operations to avoid coral impacts.

Data from all 3 Impact Management Zones have been considered both during the pre-dredging baseline period (where available) and during dredging.

There is no clear and convincing evidence that changes in turbidity in Zone C have resulted directly from dredging. This conclusion is supported by the following observations:

- Impact sites have not shown any sustained (long term) increases in turbidity relative to the Reference sites that are outside the Potential Zone of Influence.
- Investigations have identified natural events (primarily cyclones), instrument malfunction and low within-site variation as the primary contributors to exceedences to date.
- Impact sites have not shown any consistent increases in turbidity relative to pre-dredging (baseline) levels.
- While turbidity has fallen since dredging stopped on June 6, the fall has been the same at the Impact sites and Reference sites. If this fall was dredge related, a larger fall at the Impact sites would be expected.
- Measurement of turbidity across Management Zones has shown that even when turbidity is high in Zone A during dredging, it decreases rapidly at sites further from dredging.

[1] 7-day running median suspended sediments concentration at any coral monitoring site is greater than the 7-day running 80th percentile of the reference site/s data collected at the same time”

1.0 INTRODUCTION

Woodside Burrup Pty Ltd (Woodside) is undertaking capital and maintenance dredging for the Pluto LNG development in Mermaid Sound, northern Western Australia. Environmental management is effected under a Dredging and Spoil Disposal Management Plan (the DSDMP)(SKM 2008).

In response to the requirements of Schedule 4 of the Ministerial Statement, Appendix E of the Dredging and Spoil Disposal Management Plan has established a program of water quality monitoring to examine the water quality within the zone of predicted impact and the influence of the dredging and disposal operations.

The first phase in the dredging program is now complete and a review of changes in water quality to date is required as part of the planning process for the second phase of dredging.

The review focuses on water quality changes in the inner and outer Zone C Impact and Reference sites since the start of dredging in November 2007.

There are no water quality triggers outside of Zone C and water quality data collected in the other zones and/or outside the time of dredging are used largely for contextual information to evaluate whether dredging has altered turbidity.

Table 1. Terms and abbreviations used in the review

Term	Description
DEC	Department of Environment and Conservation
DEMG	Dredge Environmental Management Group
DSDMP	Dredging and Spoil Disposal Management Plan
MODIS	Moderate Resolution Imaging Spectroradiometer
Nephelometer	Instrument used to measure turbidity
NTU	Nephelometric Turbidity Unit
NWQMS	National Water Quality Management Strategy
OBS	Optical backscatter
SSC	Suspended sediment concentration (mg/L)
Turbidity	The cloudiness or haziness of a fluid caused by suspended solids

2.0 MANAGEMENT ZONES

The Impact Management Zones developed for this dredging program were derived from an iterative process between Woodside and the DEC. During this process a Zone of Potential Influence was defined using numerical modelling with consideration of both literature reviewed and the results of a baseline monitoring program.

The Impact Management Zones and the Zone of Potential Influence are shown in Figure 1. There are three management zones and these have been defined on the basis of a combination of:

- The characteristics of the coral communities therein, including ecological value;
- The proximity to elevations of sedimentation and turbidity during the dredge programme;
- The potential to manage impacts within each zone; and
- The boundaries of the proposed Dampier Archipelago Marine Park.

Management Zone A is recognised as an area where potential losses of corals will be severe. In addition to the direct physical loss of some coral habitat, there is a high risk of further losses of corals nearby as a consequence of increased sedimentation and turbidity. The level of acceptable loss within this zone is set at 100% of the corals, and there is no coral monitoring in this zone. This area is however, the focus of studies to define the turbidity and sedimentation tolerance of coral as part of the Pluto LNG Offsets program. There is no regular monitoring of water quality in this zone, but as part of the above program some water quality monitoring was carried out during the first 3 months of dredging. Some of that information is used for demonstration of context within this review.

Management Zone B is an area where some impact on corals may occur as a consequence of dredging and spoil disposal, but that is likely to be localised, with corals further away from the site of the dredging facing less risk than those closer to the boundary of Zone A. With increasing distance from the site of dredging, various management strategies become more effective, and the basis of a loss threshold of 10% averaged throughout Zone B is an expectation that dredging can be managed to remain below that threshold. There are no water quality Coral Condition Management Triggers associated with this zone; however, turbidity is measured at 4 sites to provide an early warning of turbidity plumes that may reach Zone C and to provide information on near dredge impacts on water quality. This information is also used within this review to demonstrate differences in responses to dredging related to distance from dredging.

Management Zone C is defined by the boundaries of the proposed Dampier Archipelago Marine Park, within which no loss of coral is permitted. Woodside is committed to meeting the requirements in respect of Zone C and has developed monitoring programs and management strategies that will ensure that no loss of coral occurs within the Marine Park thus ensuring protection of these valuable marine resources. There is an extensive program of monitoring within this zone that includes sites within the Potential Zone of Influence (Impact sites) and others outside the Potential Zone of Influence (Reference sites). The Level 1 Management Trigger that is currently implemented is defined as follows:

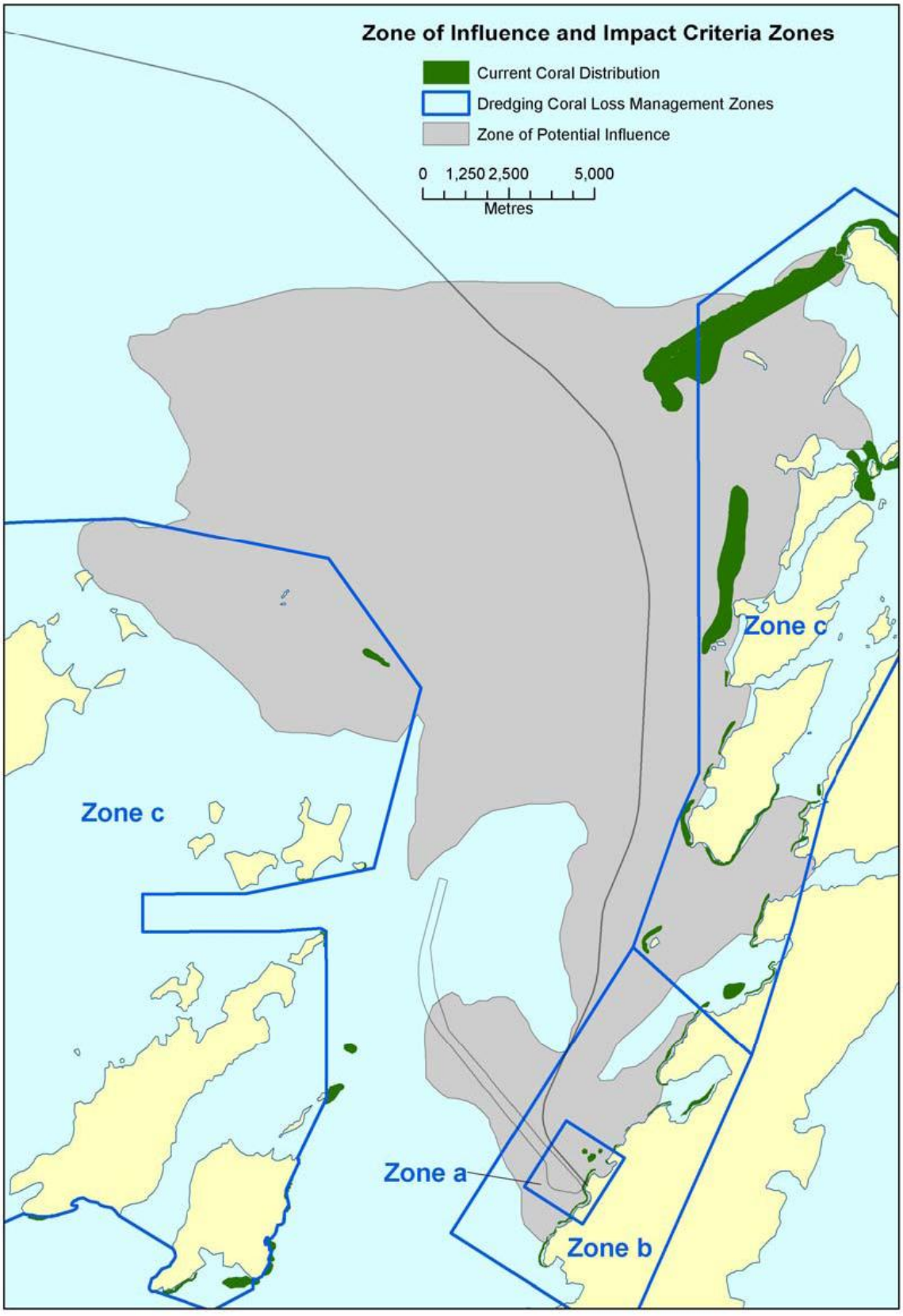
"7-day running median suspended sediments concentration at any coral monitoring site is greater than the 7-day running 80th percentile of the reference site/s data collected at the same time"

If there are exceedences of this trigger the following actions are required:

- Within 12 hours following detection of the exceedence, Woodside shall notify the DEC and provide details of the actions being taken to reduce turbidity-generating activities which are affecting that site; and
- Within 24 hours of the criterion being exceeded, Woodside shall implement management actions to keep impacts within approved limits.

Within this review, overall changes in water quality in Zone C during dredging have been assessed. Comparisons are also made with data collected during a 9 month baseline monitoring period.

Figure 1. Zone of Potential Influence and Impact Management Zones



3.0 REVIEW OF WATER QUALITY

3.1 DATA COLLECTION

3.1.1 BASELINE

Baseline turbidity measurements (pre-dredging) were made at WINI, ANGI, CHC4, TDPL, KGBY, HGPT and MIDR. The monitoring at these sites started in August 2006 (except for KGBY and TDPL - started in November 2006) and continued until May 2007. HSHL was also monitored for one month in 2006 (Aug/Sept). The monitoring was not continuous during these periods with some information lost due to instrument malfunction or cyclone activity. The loss of data around cyclones means the extremes in turbidity expected during cyclones are missing from this data set. Full details of site locations and methods of collection and analysis have been described previously (MScience 2007).

The instruments used were the SAS meters developed by Dr Peter Ridd of James Cook University. These collect optical backscatter data (OBS) from a horizontal sensor and convert this to turbidity via an internal calibration (Thomas and Ridd 2005). The data was calibrated empirically using sediments collected from adjacent to the meter to provide a way to interpolate suspended sediment concentration (SSC) in mg/l. The data was checked for quality and cleaned as necessary by experienced researchers from James Cook University.

The instruments, while deployed and functioning, measured turbidity every 10 minutes. For the purpose of analysis each individual data point was aligned according to the nearest 10 minute interval for each time and day that data was available. For example any measurement made between 0945 and 0955 was assigned a measurement time of 0950.

For the purposes of this review turbidity is used as the unit of comparison rather than SSC. This is to ensure results are not confounded by the use of inconsistent conversion factors between years and sites.

3.1.2 MONITORING ZONE B AND ZONE C DURING DREDGING

Dredging commenced on November 22, 2007. Since this time, turbidity has been monitored at 25 sites. Sites names and categories are listed in Table 2 and locations shown in Figure 2.

A range of new instruments has been deployed. At 10 sites OBS3+ sensors (D & A Instruments), connected to telemetry units transmit OBS readings to a central processing computer every 30 minutes (each transmission contains 3 x 10 minute readings). At the other 15 sites Wetlabs (ECO-NTU-SB OBS turbidity recorder) instruments measure OBS every 10 minutes and internally log. These are downloaded approximately every 2 weeks. As a back-up Alec Instruments (*COMPACT CLW* - Miniature Turbidity /Chlorophyll Data Logger) OBS loggers have been used occasionally. Some of the SAS meters developed by Dr Peter Ridd of James Cook University were used at Contingency sites in the first month of dredging, most notably at HGPT in December 2007.

Data from periods of known instrument or wiper malfunction have been excluded from the analysis. In addition, because OBS data can suffer from periodic short

spikes due to a variety of factors (such as fish or weed) occluding the omitted signal, the turbidity results were also cleaned by removing any point that was more than 2.5 times the average of its neighbours. These points were replaced with the average of the 2 neighbours. At the same time any isolated extreme values were removed. The process excluded any values that both exceeded 200 NTU and were higher than the 95 percentile of all measurements made over the previous 6 hours. Following this the data was graphed and then further visually assessed for quality.

For the purpose of analysis each individual data point was aligned according to the nearest 10 minute interval for each time and day that data was available as described above.

In this review dredging data collected since November 22, 2007 and available on August 20, 2008 has been analysed. As indicated for the baseline data, turbidity is used as the unit of comparison rather than SSC. This is to ensure results are not confounded by the use of inconsistent conversion factors between years and sites.

It is recognised that turbidity alone has limitations; however, in order to achieve the required utility for a reactive management program turbidity is considered to be the most appropriate option for direct measurement.

3.1.1 MONITORING IN ZONE A DURING DREDGING

Phase 1A of the Offsets Program was designed to record water quality and sedimentation data in Zone A for 2 months at the start of dredging (December 20, 2007 to February 13, 2008) and assess coral community impacts at any times when visibility allows diving operations to proceed safely and effectively. At 3 sites within Zone A (Figure 3), nephelometers were deployed. The instruments deployed at DPAN provided unreliable results and have been excluded from this review. At the other 2 sites (HOLD and CHC4) Alec Instruments (*COMPACT CLW* - Miniature Turbidity /Chlorophyll Data Logger) OBS loggers were used. Data was cleaned and managed as described above for other sites and times.

Table 2. Monitoring sites for water quality

Site Name	Position		Measurement method
	Easting	Northing	
Inner Zone B Impact			
SWIT	476529	7723696	*Telemetered*
SUP2	473395	7719676	*Telemetered*
NWIT	477059	7725275	Logged
SCON	477573	7726161	Logged
Inner Zone C Impact			
ANG3	478380	7731192	*Telemetered*
CONI	476837	7729162	*Telemetered*
ANGI	478711	7734574	Logged
GIDI	478784	7736380	Logged
ANG2	477632	7731862	Logged
COBN	479487	7728716	Logged
Inner Zone B & C Reference Sites			
WINI	459616	7712772	*Telemetered*
MIDI	464027	7714214	*Telemetered*
Outer Zone C Impact Sites			
HAM4	480692	7748006	Logged
NELS	466203	7738649	*Telemetered*
HAM3	478293	7746613	*Telemetered*
LANI	460932	7739109	Logged
CRTS	469188	7736562	Logged
Outer Zone C Reference Sites			
MIDR	464293	7735387	*Telemetered*
MAL2	463075	7731240	*Telemetered*
Coral Inner Zone C Reference Site			
FFP1	481113	7734282	Logged
MALI	468088	7730742	Logged
Coral Outer Zone C Reference Sites			
LEGD	483519	7749430	Logged
Coral contingency Mid Zone C Impact Sites			
HGPT	467093	7728731	Logged
ELI1	466472	7722175	Logged
Coral contingency Inner Zone C Impact Sites			
KGBY	472454	7717680	Logged

Figure 2. Map of all water quality sites

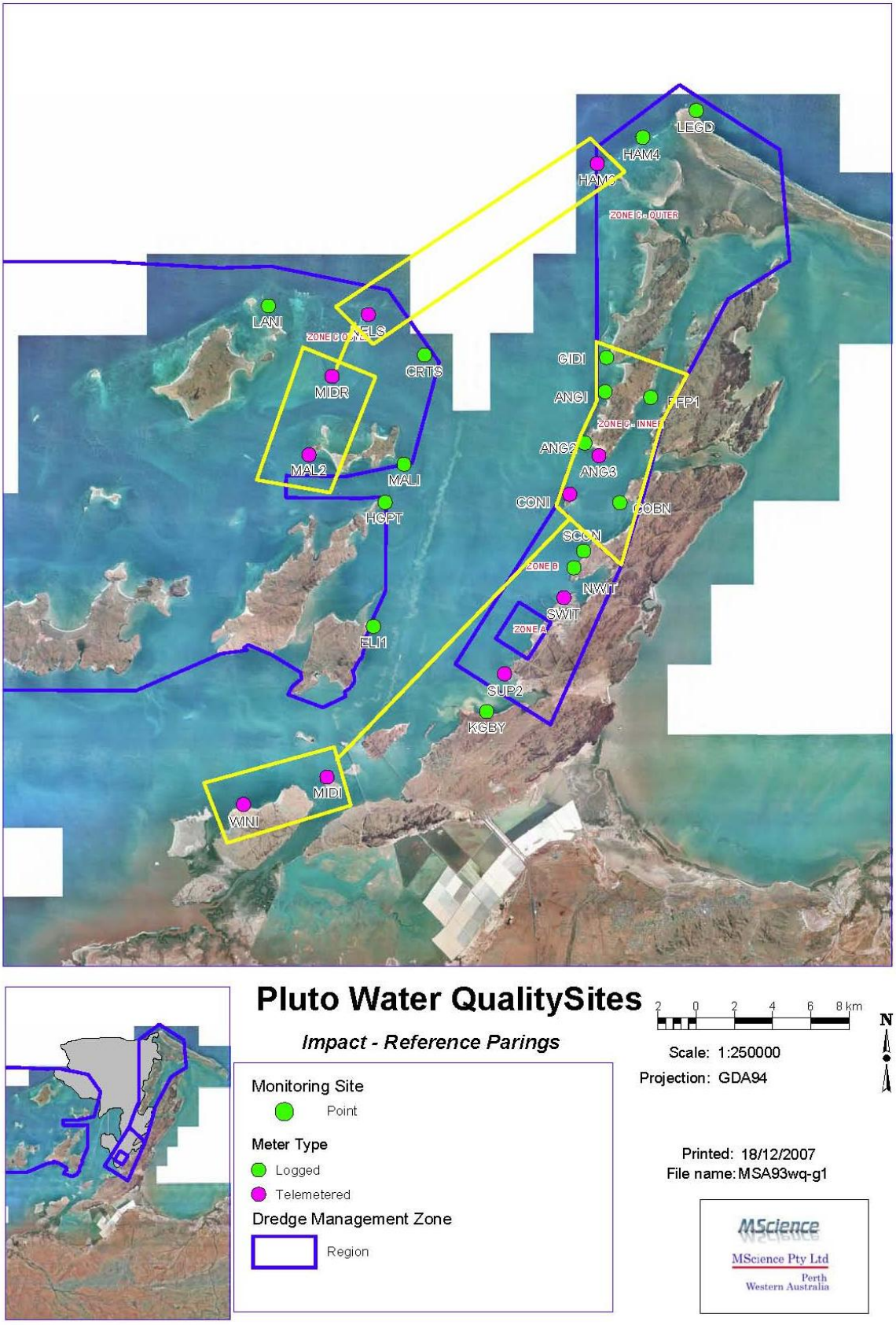
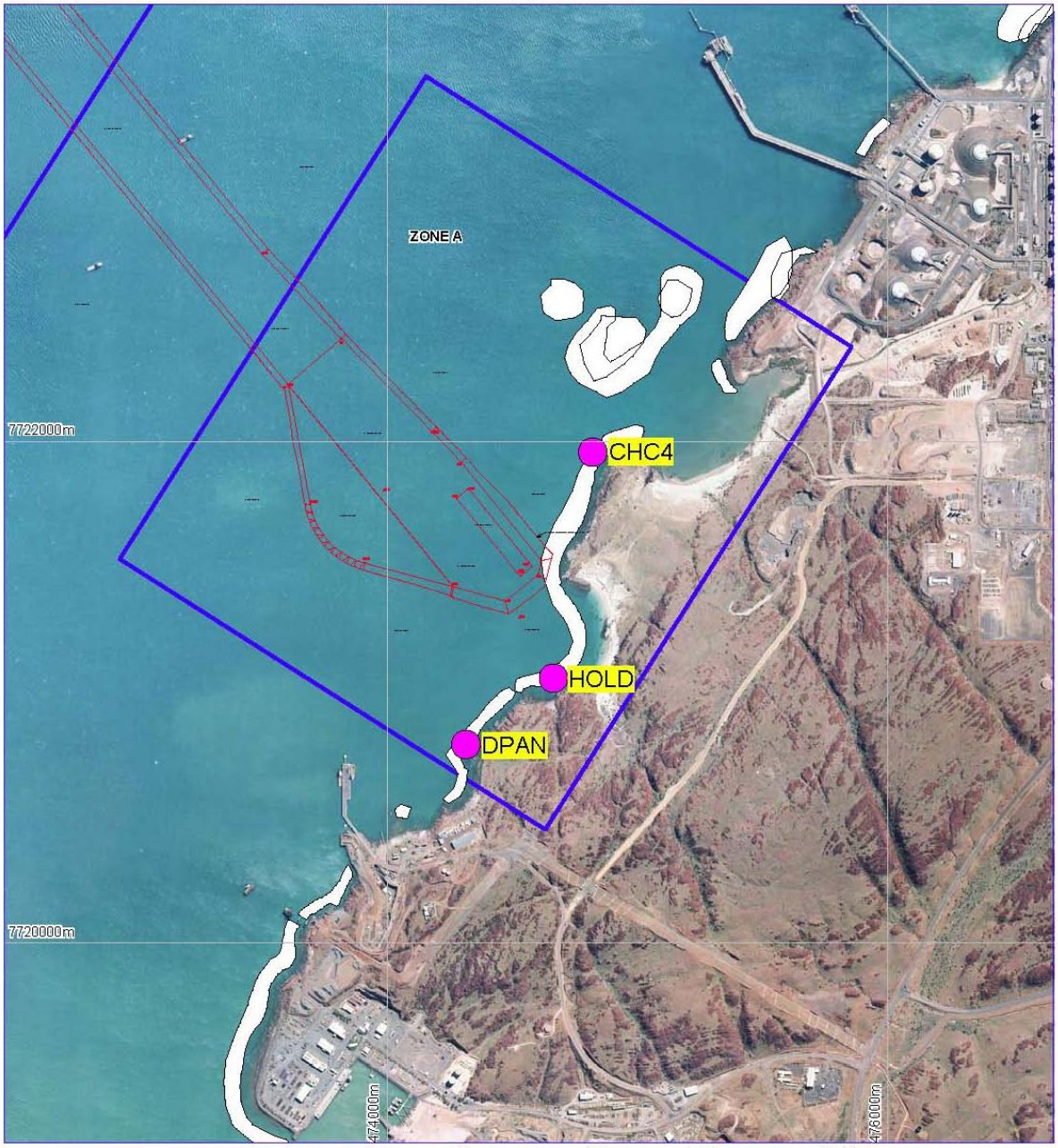


Figure 3. Water quality and coral monitoring sites in Zone A



Zone A Locations Phase 1A

Coral and monitoring sites in relation to dredging.

Projection: GDA94 (zone50)

N

Monitoring Site
Point

Dredge Management Area
Region

Dredging areas
Region

Printed: 7/12/2007
File name: MSA101za3

MScience
MScience Pty Ltd
Perth
Western Australia

3.2 COMPARISONS BETWEEN BASELINE AND DREDGING FOR SELECTED ZONE C SITES

Turbidity during the baseline and dredging period is compared in Figure 4 and Figure 5. This has only been possible at sites that have been monitored at both times. These sites provide a mixture of inner Reference (WINI) inner Impact (ANGI), outer Reference (MIDR) and mid Contingency Impact (HGPT).

Change in turbidity between baseline and dredging will be due to:

- Differences between instruments;
- Different sets of turbidity generating metocean conditions;
- Any suspended sediment added by dredging or disposal.

All three factors will operate at Impact sites, but only the first two will affect turbidity at Reference sites. Therefore, if dredging has been influencing turbidity at the Impact sites, it would be expected that these sites would show a larger change from baseline than Reference sites.

The monthly medians at Impact site ANGI during dredging have been similar to the monthly medians during baseline monitoring. The monthly median at this site during dredging has only exceeded the monthly 80th percentile of the baseline turbidity on one occasion. This was during February 2008 while the site was under the influence of Cyclone Nicholas (Figure 4).

The monthly median at Reference site WINI has tended to be slightly higher than the monthly baseline median for much of the dredging period. In March and August, it was higher than the baseline 80th percentile.

The monthly medians at Contingency Impact site HGPT during dredging have been similar to the monthly medians during baseline monitoring for 3 of the 6 months that are comparable. The monthly median at this site during dredging exceeded the monthly 80th percentile of the baseline turbidity on 3 occasions. These were during December, February and March 2008, months when water quality was influenced by tropical cyclones (Cyclones Melanie, Nicholas and Pancho) (Figure 5). There has been no evidence that HGPT has been influenced by dredging during any of these periods. The very high median at HGPT in December 2007 was associated with Cyclone Melanie and the use of an SAS meter at this site. Some of the values were consistent with instrument fouling but this was not confirmed during subsequent maintenance. The high values were not consistent with turbidity changes at sites closer to dredging.

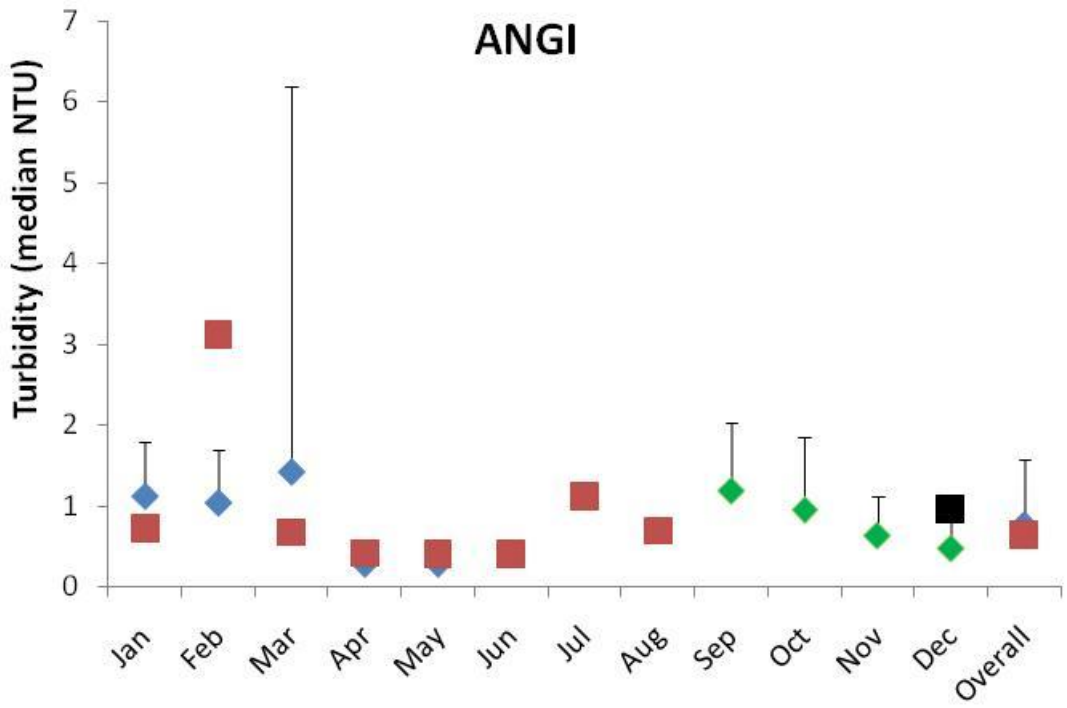
The monthly median at Reference site MIDR has tended to be slightly higher than the monthly baseline median for much of the dredging period. In February and March monthly medians were higher than the baseline 80th percentiles (Figure 5).

Comparisons between baseline and dredging data in Zone C indicates that:

- **There is no strong evidence that the Impact sites have shown any sustained increases in turbidity during dredging relative to pre-dredging;**
- **The tendency for Reference sites and not Impact sites to show a slight elevation in turbidity relative to baseline suggests differences between dredging and baseline are more likely to be related to seasonal differences or instrument differences than dredging.**

These conclusions should be viewed as indicative only. Data are not available for comparison across all months and different instruments were used during the 2 periods.

Figure 4. Comparison of turbidity during the baseline (♦ 2007 ♦ 2006) and dredging (■ 2007 ■ 2008) periods. Bars indicate the 80th percentile of the baseline



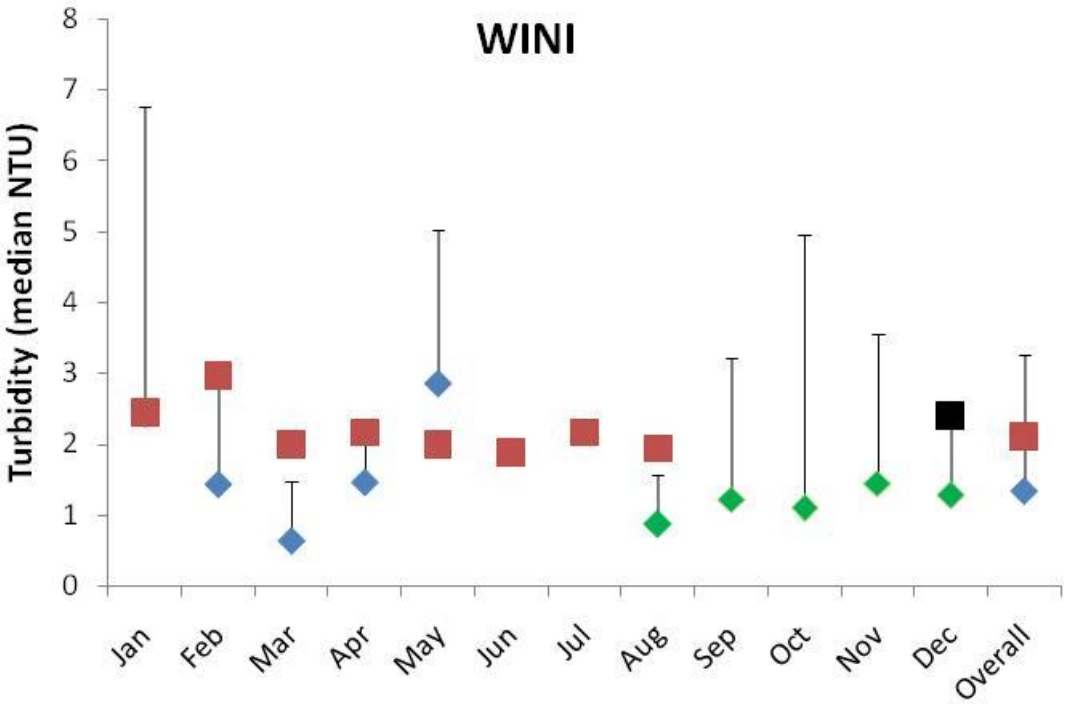
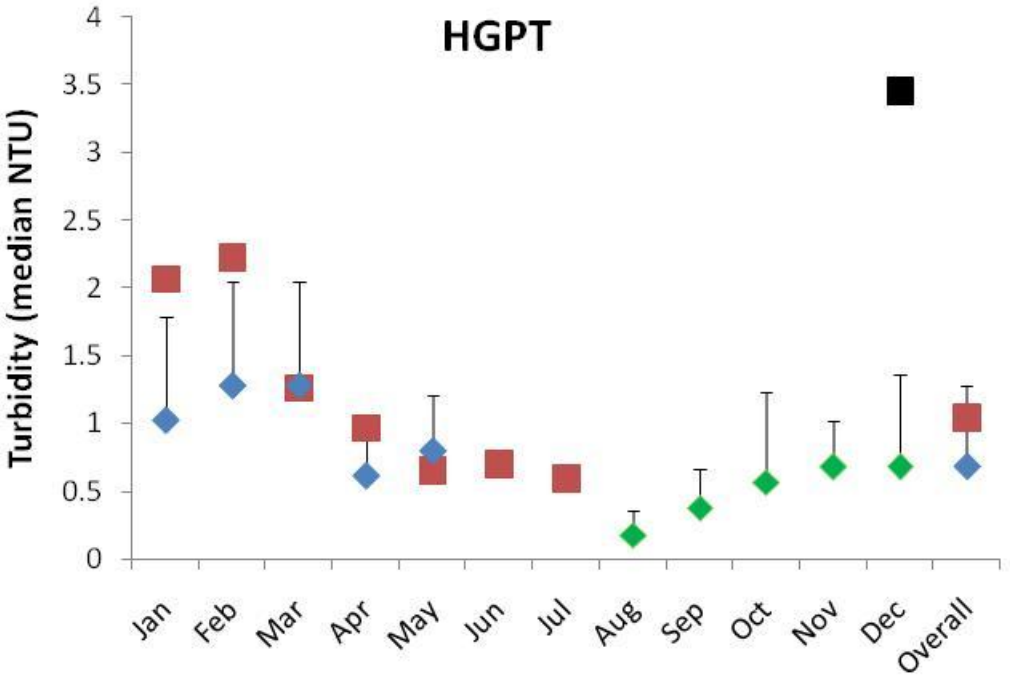
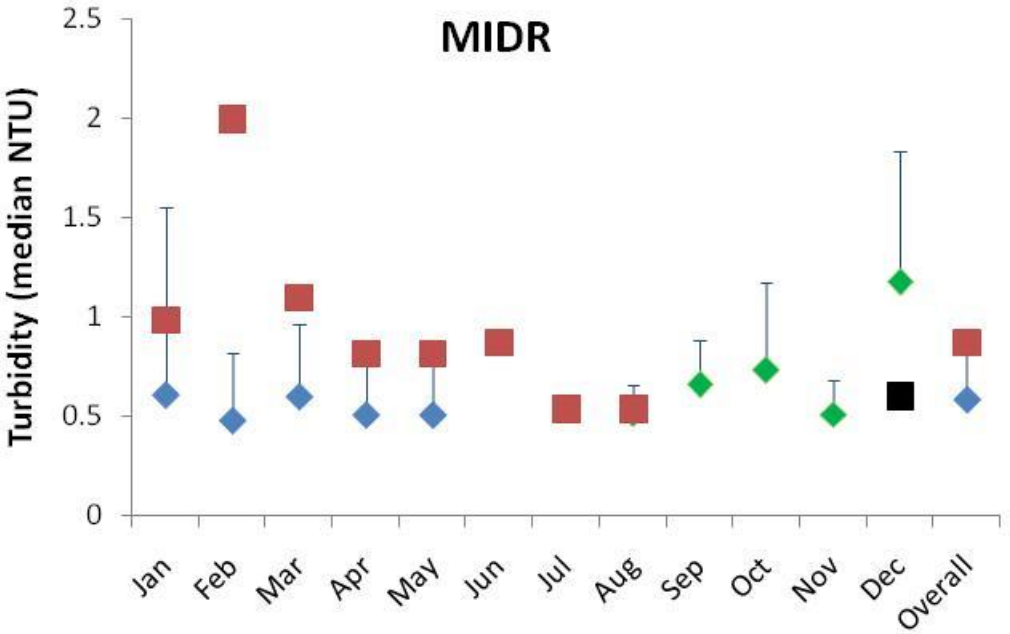


Figure 5 Comparison of turbidity during the baseline (♦ 2007 ♦ 2006) and dredging (■ 2007 ■ 2008) periods. Bars indicate the 80th percentile of the baseline





3.3 COMPARISON BETWEEN BASELINE, ZONE A AND ZONE B

The comparison between the Zone A site (CHC4) during the baseline and the 2 Zone A sites (CHC4 and HOLD) during the first 3 months of dredging, provides a demonstration of the changes in water quality close to dredging. The monthly medians and means at CHC4 and HOLD during dredging were up to 10 times higher than at CHC4 during the non dredging baseline period a year earlier (Figure 6, A and B). The highest 5% of turbidity measurements (95th percentile) were up to 20 times higher than the baseline 95th percentile (Figure 6, C).

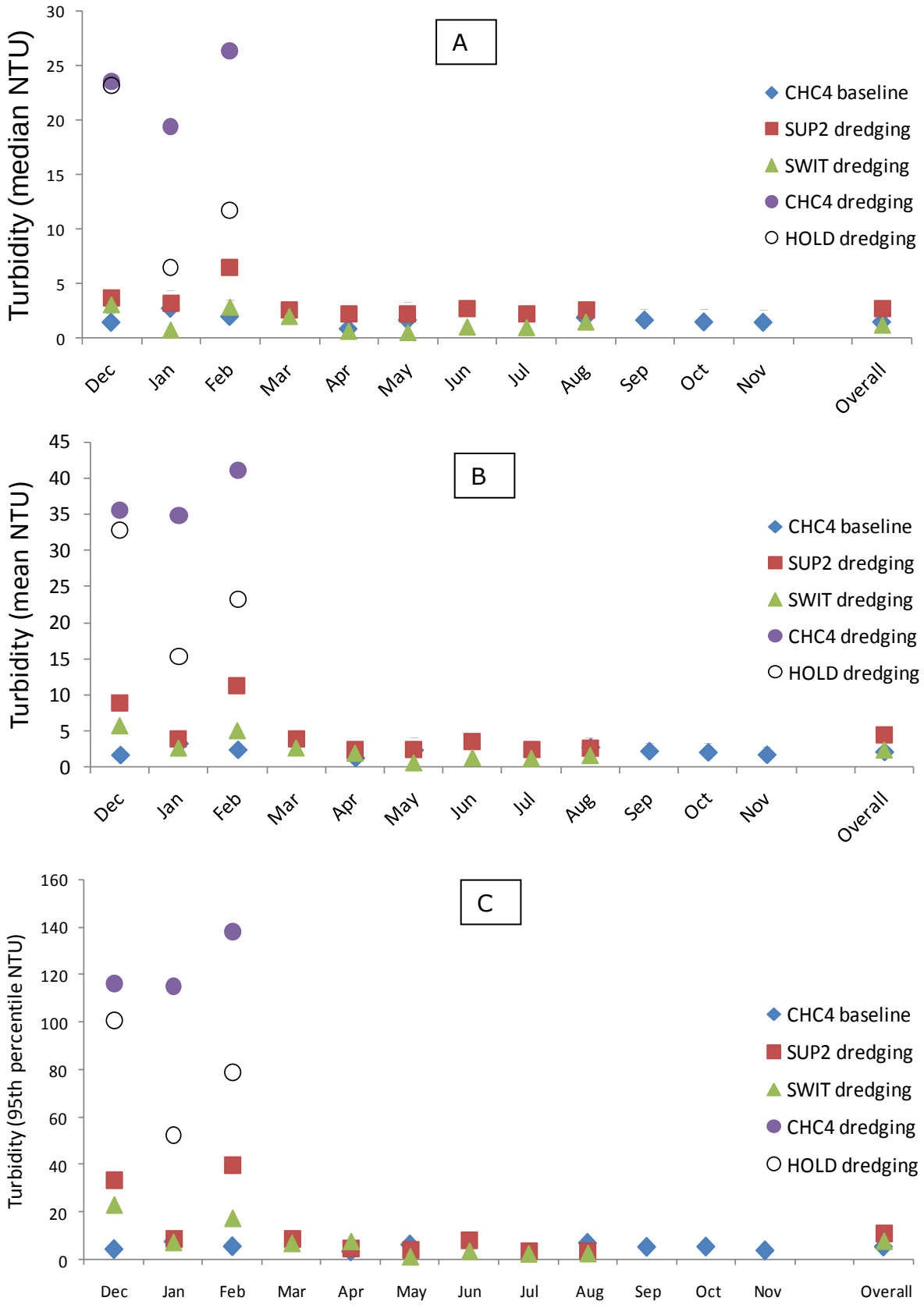
The mean, median and 95th percentile at the SUP2 and SWIT Zone B sites during the first 3 months of dredging were consistently higher than the same statistics for CHC4 during baseline monitoring but have not shown any sustained elevation in median or mean or 95th percentile since March 2008 (Figure 6).

The monthly mean, median and 95th percentile of the SUP2 and SWIT sites were consistently well below the comparative statistics of the Zone A sites during dredging in December, January and February.

Comparison between baseline and dredging in Zones A and B indicates that:

- **There was a consistent dredge related elevation in turbidity in Zone A during the first 3 months of dredging; this was highest to the north of dredging;**
- **Water quality in Zone B was less susceptible to dredging than in Zone A;**
- **Much of the increase in turbidity caused by dredging in Zone A did not carry over into Zone B.**

Figure 6. Comparison of baseline turbidity at CHC4 with turbidity during dredging in Zone A (CHC4 and HOLD) and Zone B (SUP2 and SWIT) sites. A - monthly median, B – monthly mean, C – monthly 95th percentile



3.4 COMPARISON OF ZONE C IMPACT AND REFERENCE SITES DURING DREDGING

The 7 day median turbidity for inner and outer Impact sites was calculated for comparison with the 7 day 80th percentile of the relevant Reference sites. Sites were excluded if less that 400 measurements had been made during the previous 7 days.

3.4.1 INNER ZONE C SITES

The 7 day median turbidity at the inner Zone C Impact sites has remained below 5 NTU for all but 4 of the 36 weeks in the study period. The medians higher than 5 NTU have all been around times of cyclonic activity (Figure 7, Figure 8).

Outside of the cyclonic periods the differences between Impact site medians and Reference site 80th percentiles has remained relatively constant at approximately 1 - 2 NTU. There has not been a convergence trend in these statistics between Reference and Impact sites over time, indicating there has been no sustained upward drift in turbidity at the Impact sites.

The exception to this observation has been at the ANG3 site, from early April, the 7 day median turbidity drifted up towards the pooled inner Reference 80th percentile. After a series of short term exceedences at this site the sensor at ANG3 was removed, tested and found to have drifted out of calibration by approximately 1 NTU. It has been returned to the manufacturer for recalibration. This data remained within the analysis because it does not meet the rules for exclusion (see page 7); consideration will be given to baseline correction following instrument recalibration.

3.4.2 OUTER SITES

The 7 day median turbidity at the outer Zone C Impact sites has remained below 4 NTU for all but 2 of the 36 weeks in the study period. The medians higher than 3 NTU have all been around times of cyclonic activity (Figure 9, Figure 10).

Outside of the cyclonic periods the differences between Impact site medians and Reference site 80th percentiles has remained constant at <2 NTU. The closeness of the medians and 80th percentiles at these outer sites is a reflection of the very low variability in NTU within any 1 week analytical period. There has not been a convergence trend in these statistics between Reference and Impact sites over time, indicating there has been no sustained upward drift in turbidity at the Impact sites.

The exception to this observation has been at the HAM3 site, from early July, the 7 day median turbidity drifted up towards and eventually passed the pooled inner Reference 80th percentile. At this site the sensor was removed, tested and found to have drifted out of calibration by approximately 1 NTU. It has been returned to the manufacturer for recalibration. This data remained within the analysis because it does not meet the rules for exclusion described earlier (see page 7), consideration will be given to baseline correction following instrument recalibration.

Comparison between the Reference and Impact sites over the past 8 months, based on 7 day statistics has indicated that:

- **The large, acute changes in turbidity at Impact sites have all been related to cyclones and/or increased swell and have been accompanied by increased turbidity at Reference sites;**
- **There have been no sustained (long term) increases in turbidity at Impact sites relative to Reference sites.**

Figure 7. Seven day median turbidity at Zone C Impact sites in Conzinc Bay compared to7 day 80th percentile of pooled inner Reference sites (WINI, MIDI)

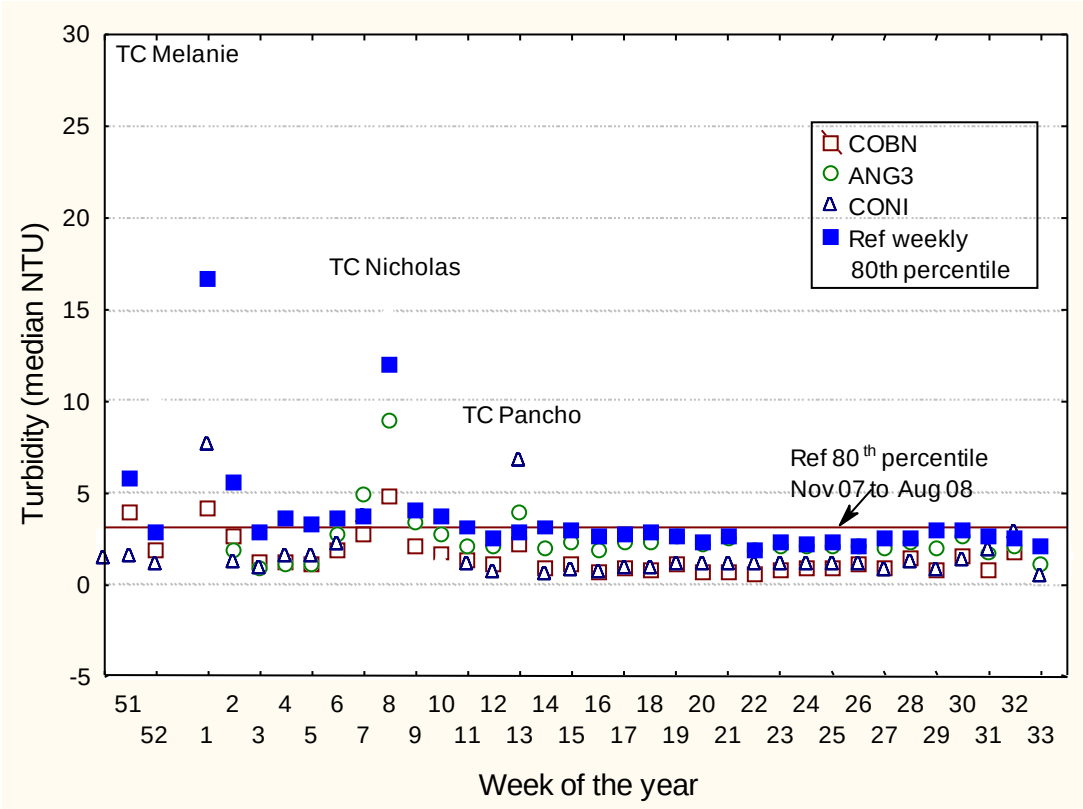


Figure 8. Seven day median turbidity at Zone C Impact sites on the west side of Angel and Gidley Islands compared to 7 day 80th percentile of pooled inner Reference sites (WINI, MIDI)

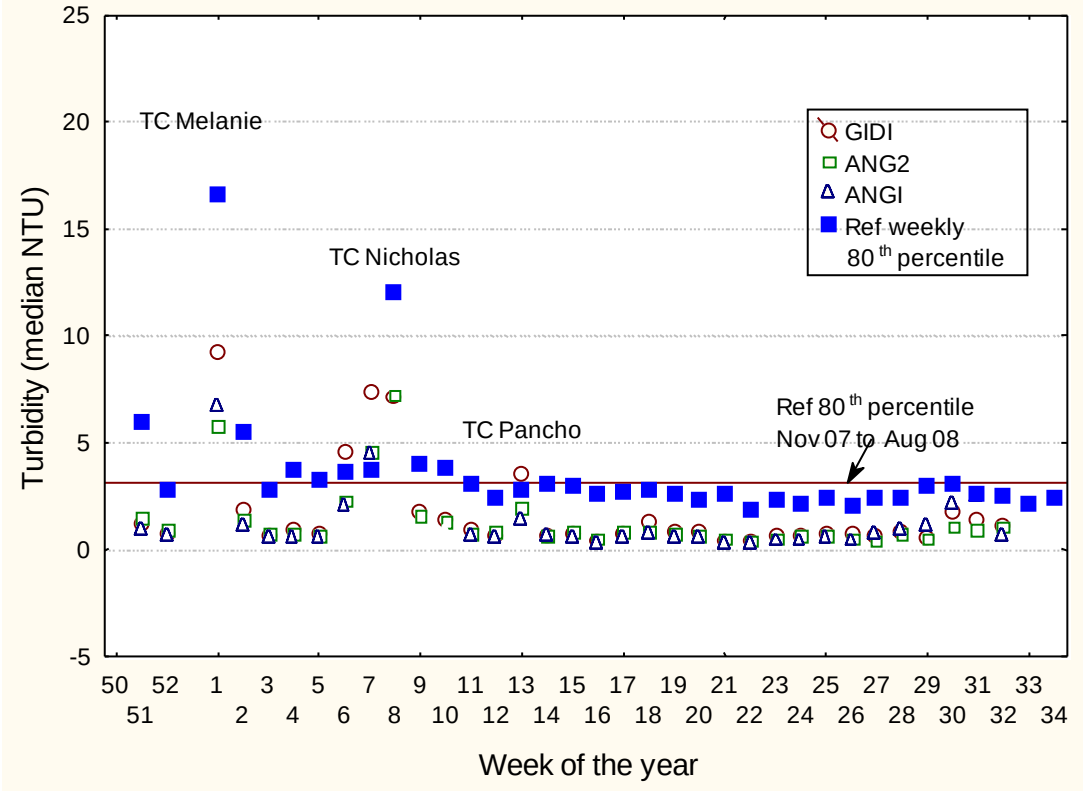


Figure 9. Seven day median turbidity at the western outer Zone C Impact sites compared to 7 day 80th percentile of pooled outer Reference sites (MIDR, MAL2)

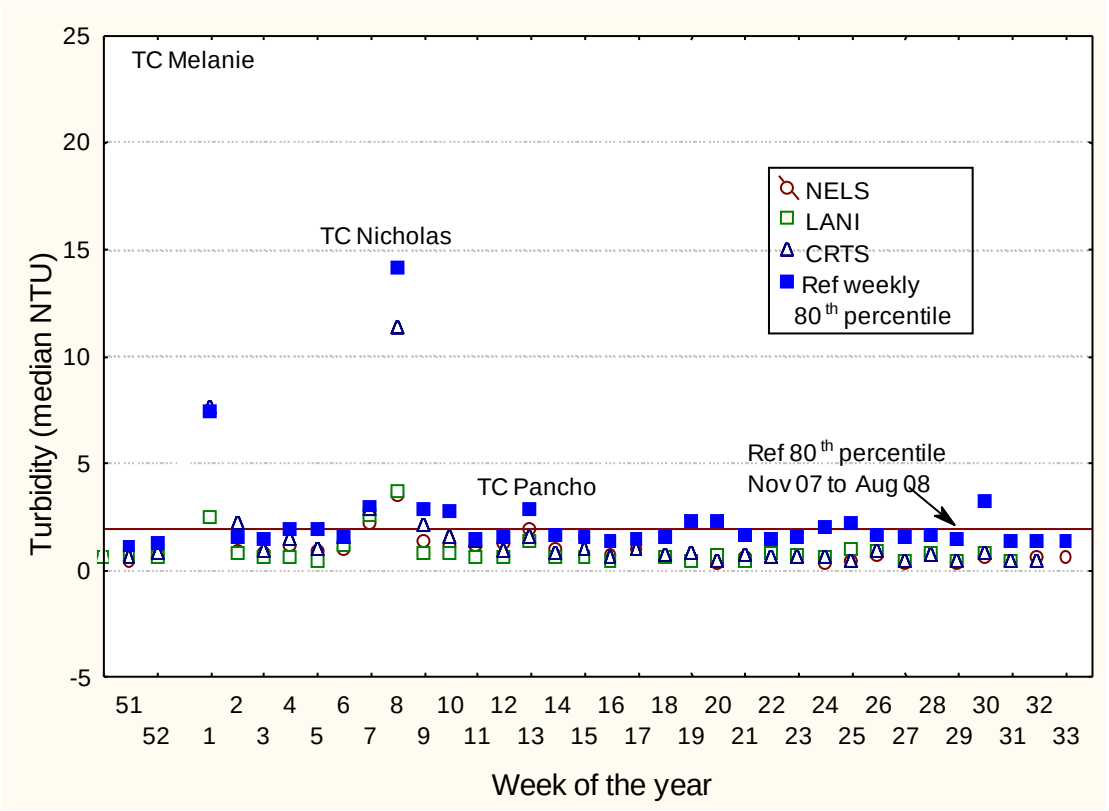
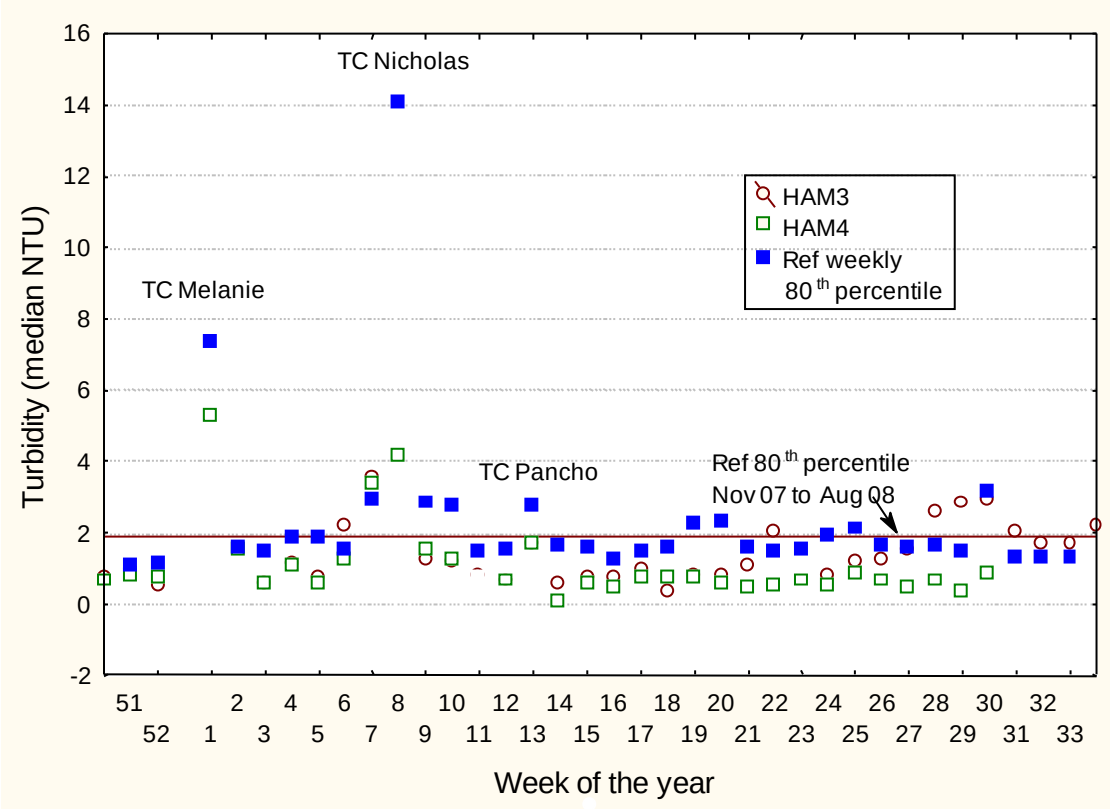


Figure 10. Seven day median turbidity at the eastern outer Zone C Impact sites compared to 7 day 80th percentile of pooled outer Reference sites (MIDR, MAL2)



3.5 DIFFERENCES BETWEEN TIMES OF DREDGING AND NO DREDGING DURING PHASE 1

Dredging began on November 22, 2007 and was stopped on June 6, 2008. This has allowed for a comparison of turbidity when dredging was underway with turbidity when no dredge activity was occurring. These differences at each individual site are shown on Table 3. The mean turbidity between November and June (dredging) was 2.19 NTU at the Zone C Reference sites and 2.13 at the Zone C Impact sites. The means after June have been 1.53 and 1.23 NTU respectively for the same groups of sites. This has meant that, over all the Zone C Reference sites, turbidity has been, on average, 0.66 NTU lower since dredging stopped, while the fall has been 0.90 NTU at the Zone C Impact sites and 1.51 NTU at the sentinel sites within Zone B. The changes at the Reference and Impact sites not statistically significantly different (P=0.21) (as assessed using a Mann-Whitney ranking test for non-parametric data)

Table 3. Change in turbidity from periods of dredging to post-dredging

Site	Site category	Mean turbidity during dredging (NTU)	Mean turbidity after dredging (NTU)	Difference between dredging and post dredging (NTU)
GIDI	Impact	2.85	1.29	1.56
ANG2	Impact	2.17	0.80	1.38
COBN	Impact	2.23	1.26	0.97
ANG3	Impact	3.35	2.10	1.25
CONI	Impact	2.74	1.56	1.18
ANGI	Impact	1.63	1.21	0.42
HAM3	Impact	1.61	2.05	-0.44
NELS	Impact	1.29	0.56	0.73
HAM4	Impact	1.68	1.18	0.50
LANI	Impact	1.36	0.86	0.50
CRTS	Impact	2.34	0.65	1.69
HGPT	Impact	2.16	0.79	1.37
ELI	Impact	2.23	1.64	0.59
KGBY	Impact	4.05	4.59	-0.54
MIDI	Reference	3.03	2.15	0.88
WINI	Reference	3.04	2.19	0.85
MAL2	Reference	2.11	1.71	0.40
MIDR	Reference	1.82	1.14	0.69
FFP1	Reference	2.40	2.03	0.37
MALI	Reference	1.71	1.06	0.66
LEGD	Reference	1.22	0.42	0.80
SWIT	Sentinel	2.80	1.33	1.47
NWIT	Sentinel	2.71	1.84	0.88
SUP2	Sentinel	4.98	2.83	2.15
SCON	Sentinel	2.84	1.29	1.54

The observation that the changes at Reference and Impact sites have been similar is consistent with dredging having no affect in turbidity at the Impact sites. If dredging had been having a direct affect on turbidity at Impact sites, then the drop at these

sites since June 6 would have been larger than that at the Reference sites. The lower post- dredging turbidity at all sites is therefore most likely related to weather and ocean conditions.

The fall in turbidity since dredging was stopped on June 6 has been similar at Reference and Impacts sites.

If dredging had been having a direct effect on the Impact sites, the decrease in turbidity would be higher at these sites than at the Reference sites.

The fall is therefore most likely related to non-dredging factors and supports the conclusion that dredging has not changed overall turbidity across the Potential Zone of Influence.

4.0 REFERENCES

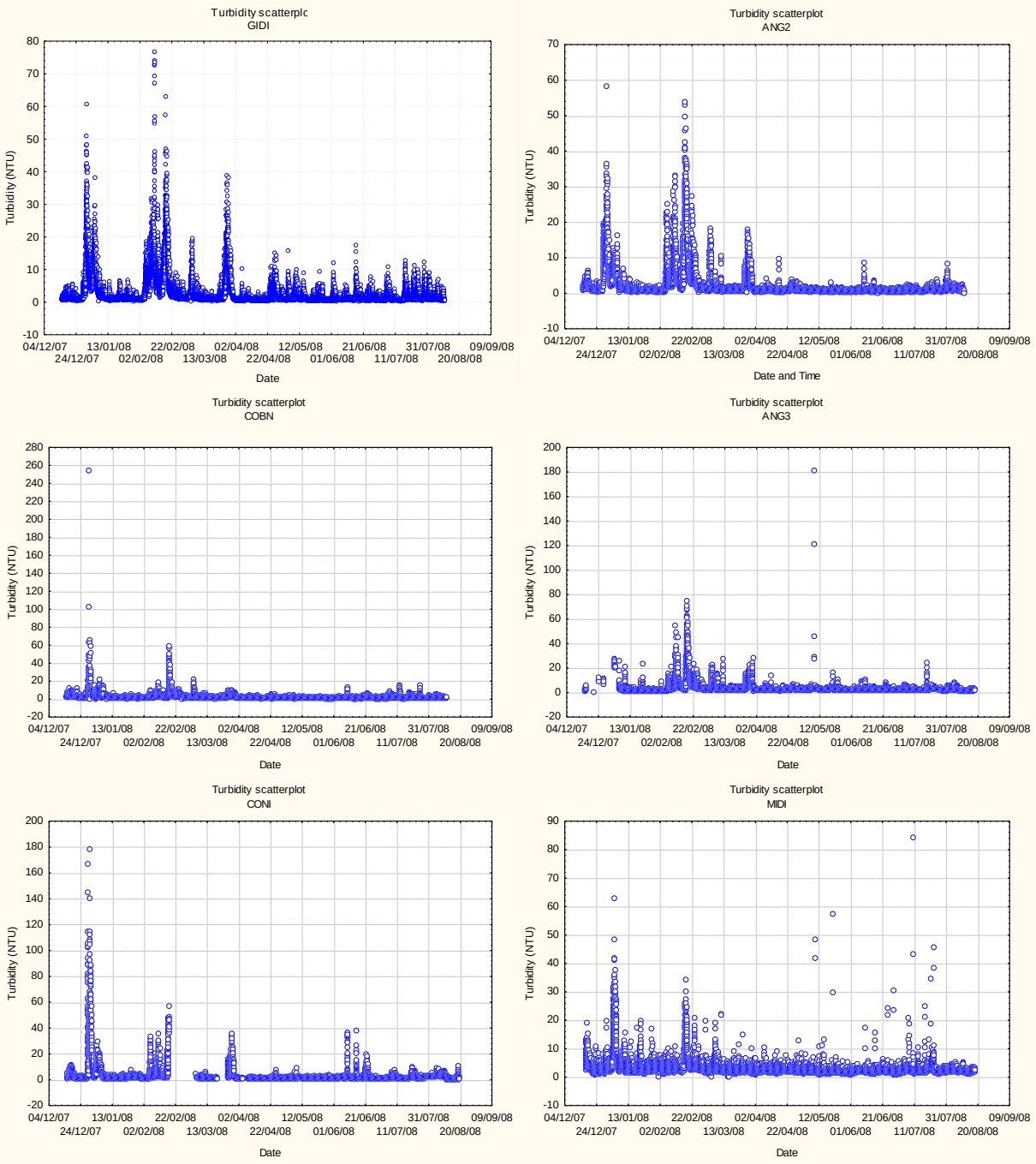
MScience (2007) Pluto LNG Development: Baseline Water Quality Assessment Report April 2007. MScience Pty Ltd for Woodside Burrup Pty Limited, MSA61R12, Perth, WA

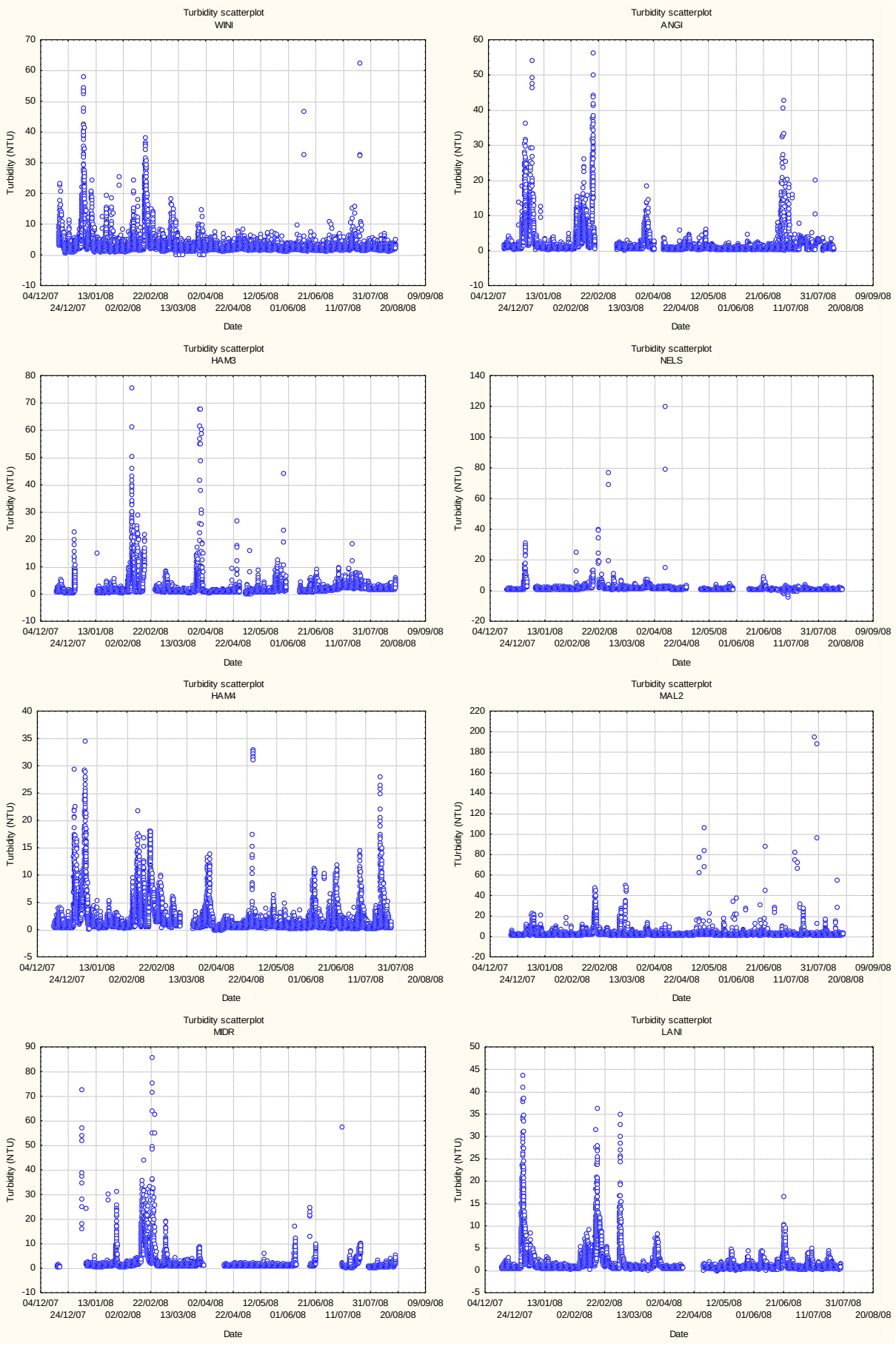
SKM (2008) Pluto LNG Development: Dredging and Spoil Management Plan/Dredge Impact Management Plan. Rev.08. Sinclair Knight Merz, Perth, Western Australia

Thomas S, Ridd P (2005) Field assessment of innovative sensor for monitoring of sediment accumulation at inshore coral reefs. Mar Poll Bull 51: 470-480

APPENDIX A – TURBIDITY SCATTERPLOTS

Figure 11. Turbidity scatterplots at all sites

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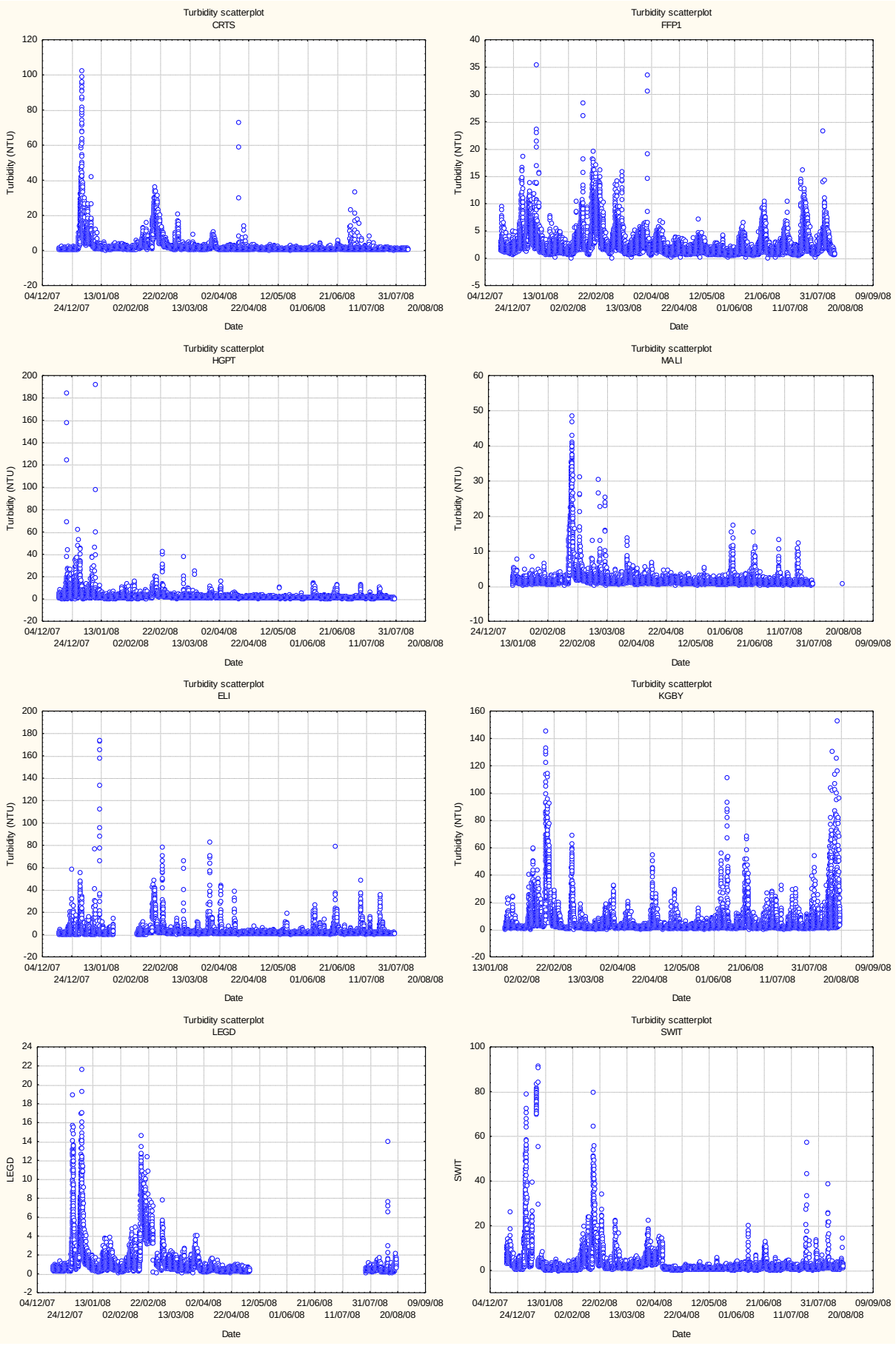
WINI
Turbidity (NTU)
Date
Turbidity scatterplot
ANGI
Turbidity (NTU)
Date
Turbidity scatterplot
HAM3
Turbidity (NTU)
Date
Turbidity scatterplot
NELS
Turbidity (NTU)
Date
Turbidity scatterplot
HAM4
Turbidity (NTU)
Date
Turbidity scatterplot
MAL2
TUrbidity (NTU)
Date
Turbidity scatterplot
MIDR
Turbidity (NTU)
Date
Turbidity scatterplot
LANI
Turbidity (NTU)
Date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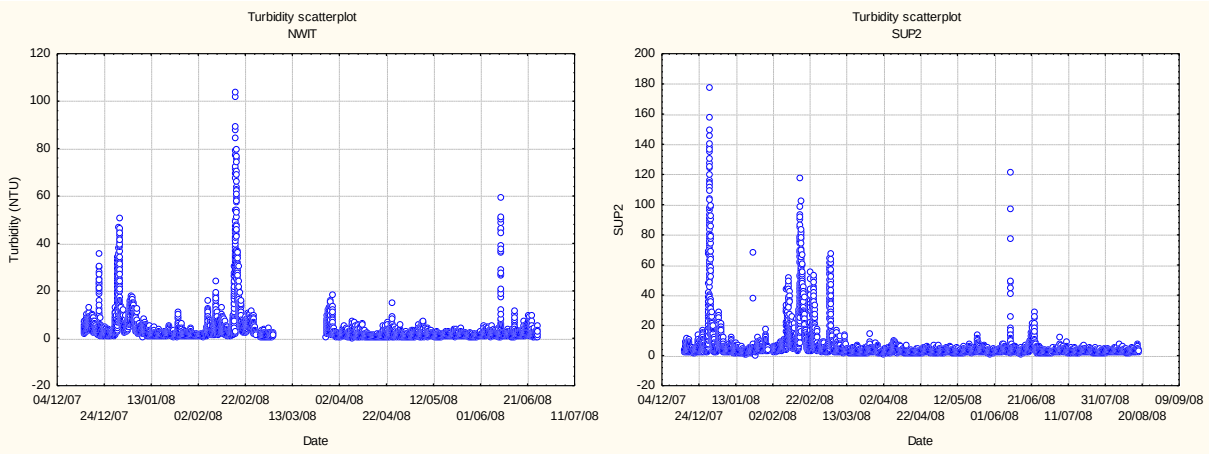
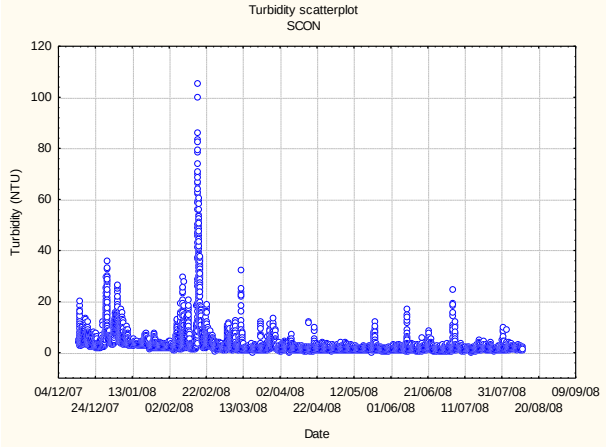
Date
Turbidity scatterplot
FFP1
Turbidity (NTU)
Date
Turbidity scatterplot
HGPT
Turbidity (NTU)
Date
Turbidity scatterplot
MALI
Turbidity (NTU)
Date
Turbidity scatterplot
ELI
Turbidity (NTU)
Date
Turbidity scatterplot
KGBY
Turbidity (NTU)
Date
Turbidity scatterplot
LEGD
LEGD
Date
Turbidity scatterplot
SWIT
SWIT
Date


Turbidity scatterplot
NWIT
Turbidity (NTU)
120
100
80
60
40
20
0
-20
04/12/07
13/01/08
22/02/08
02/04/08
12/05/08
21/06/08
24/12/07
02/02/08
13/03/08
22/04/08
01/06/08
11/07/08
Date
Turbidity scatterplot
SUP2
SUP2
200
180
160
140
120
100
80
60
40
20
0
-20
04/12/07
13/01/08
22/02/08
02/04/08
12/05/08
21/06/08
31/07/08
09/09/08
24/12/07
02/02/08
13/03/08
22/04/08
01/06/08
11/07/08
20/08/08
Date


Turbidity scatterplot
SCON
Turbidity (NTU)
120
100
80
60
40
20
0
04/12/07
13/01/08
22/02/08
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12/05/08
21/06/08
31/07/08
09/09/08
24/12/07
02/02/08
13/03/08
22/04/08
01/06/08
11/07/08
20/08/08
Date

Appendix 7 – Level 2 Criterion Exceedance Correspondence Register.

All Level 2 Coral Condition Management Trigger Criterion Exceedances to date have been attributed to this regional thermal bleaching event. This assessment has been endorsed by the Pluto DEMG and the James Cook University Centre of Excellence for Coral Reef Studies. Below lists all previously submitted L2C Criterion Exceedance compliance reports and related DEMG advice.

Subject	***Exceedance Number***	***Site***	***Reference Correspondence***		
			To	***From***	***Date(s) and/or WBPL Reference Number(s)***
Exceedance Reported to DEC	L2C-1	ANG3	DEC CEO	Woodside	PLU/GOV/00194; 26/02/2008
Exceedance Reported to DEC	L2C-2	COBN	DEC CEO	Woodside	PLU/GOV/00194; 26/02/2008
Exceedance Reported to DEC	L2C-3	MALI	DEC CEO	Woodside	PLU/GOV/00196; 28/02/2008
Exceedance Reported to DEC	L2C-4	MAL2	DEC CEO	Woodside	PLU/GOV/00196; 28/02/2008
Exceedance Reported to DEC	L2C-5	ANG2	DEC CEO	Woodside	PLU/GOV/00207; 12/03/2008
Exceedance Reported to DEC	L2C-6	ANGI	DEC CEO	Woodside	PLU/GOV/00207; 12/03/2008
Exceedance Reported to DEC	L2C-7	CONI	DEC CEO	Woodside	PLU/GOV/00207; 12/03/2008
Exceedance Reported to DEC	L2C-8	FFP1	DEC CEO	Woodside	PLU/GOV/00212; 1/04/2008
Exceedance Reported to DEC	L2C-9	GIDI	DEC CEO	Woodside	PLU/GOV/00212; 1/04/2008
Exceedance Reported to DEC	L2C-10	CRTS	DEC CEO	Woodside	PLU/GOV/00212; 1/04/2008
DEMG Advice Regarding Mermaid Sound thermal bleaching event	L2C 1-10	-	DEC CEO and Woodside	DEMG	7/04/2008
Exceedance Reported to DEC	L2C-11	LANI	DEC CEO	Woodside	PLU/GOV/00220; 15/04/2008
Exceedance Reported to DEC	L2C-12	NELS	DEC CEO	Woodside	PLU/GOV/00220; 15/04/2008
Exceedance Reported to DEC	L2C-13	HAM3	DEC CEO	Woodside	PLU/GOV/00220; 15/04/2008
Exceedance Reported to DEC	L2C-14	MIDR	DEC CEO	Woodside	PLU/GOV/00220; 15/04/2008
Exceedance Reported to DEC	L2C-15	HAM4	DEC CEO	Woodside	PLU/GOV/00245; 20/05/2008
DEMG Recommendation Regarding the review by Dr A.Baird of "Bleaching Patterns across the Pilbara in Early 2008"	All Level 2 Exceedances	-	DEC CEO and Woodside	DEMG	20/10/2008

Note: All L2C exceedances are made available to the DEMG via email distribution and access to Woodside maintained website. Survey reports are posted following completion of each survey.