DISCUSSION

Seagrass Area and Distribution Patterns

The silty layer found at sites north of the dredged access channel in November 1998 was found at only a few sites in December 1999, and seagrass distribution and biomass had returned to near pre-dredging levels. Although the source of the silt cannot be accurately determined, the layer may have resulted from changes in hydrology when the dredged channel was created – collecting and directing silts from the mangrove fringe, through the channel and depositing them offshore north of the channel. This model of hydro- and sediment-dynamics was originally suggested by Wolanski (Australian Institute of Marine Science (AIMS), Pers. Comm.) but has not been tested. Silt deposition patterns probably change according to tide and flow conditions. Results of this survey indicate that silt deposition patterns one year after the capital dredge and excavation works at Oyster Point has not caused detectable changes in seagrass distribution and abundance.

The dredged channel may still cause re-distribution of inshore silts to the offshore northern area, possibly over the long-term (greater than 5 years). It would be most appropriate to test for persistence of this silt layer (and survival of local seagrasses) by conducting additional monitoring at a frequency of every 3-5 years).

There has been little change in seagrass distribution and area (all species and meadows pooled) at Oyster Point over the 4 year study period (Map 2). Distribution patterns of the major species changed little, with a persistent nearshore band of *Halodule uninervis* dominating the intertidal extent of seagrass meadows and a broad *Halophila ovalis* band subtidally. The only major species that did vary greatly between years was *Halophila decipiens*, which increased, declined 80% and increased again to its original (1995) area, between monitoring events. *Halophila decipiens* is an ephemeral species with large natural fluctuations in abundance and distribution seasonally and between years (Birch and Birch 1984; McKenzie et al. 1996; McKenzie et al. 1998). Large changes in *Halophila decipiens* distribution were mostly in areas distant from Oyster Point and were likely due to natural changes.

While the maximum depth ranges of the major species in 1997, 1998 and 1999 were shallower than in 1995, there was no corresponding difference in the distribution and GPS derived location of the meadows. There were also no large changes in bottom topography that could explain these differences in seagrass depth. The shallower maximum depth ranges of the major species in December 1997 and November 1998 may be a result of lower light availability caused by increased wind driven turbidity in the two month period leading up be these surveys. Maximum depths for the major species remained shallow in December 1999. The depth range of *Halophila decipiens* did deepen in December 1999, however it is unclear as to why *Halophila ovalis* and *Halodule uninervis* maximum depths continued to be shallow. Depth ranges were affected by the presence of only a few plants at the deeper extent of distribution and the 1999 survey may have missed these isolated *Halophila ovalis* and *Halodule uninervis* plants.

Seagrass Biomass

The chosen "reference" regions were so different from the survey regions in prevailing wind, water quality and seagrass biomass that they were not considered reliable "controls" for BACI-type analyses of impacts on Oyster Point seagrasses. For

species that are naturally highly variable, reference or control sites are very difficult to use for analysis of impacts. Instead, we analysed for changes in seagrass with distance from the source of impact and considered the ‘reference’ regions as north-south extensions of the core monitoring area.

Seagrass biomass at Oyster Point declined overall (approximately 45% for all species pooled) from 1995 to 1998, then increased (approx 80%) to near the 1995 levels in December 1999. These variations are within the known range of natural change for these seagrass species. For colonising tropical Australian seagrasses, a 50% to 70% decline in the biomass and distribution is thought necessary to trigger management intervention (Coles et al. 1996b; Lee long et al. 1996). Low-biomass meadows of *Halophila ovalis*, *Halophila decipiens* and *Halodule uninervis* (narrow-leaf) probably vary naturally by up to 70% (eg. at Mourilyan Harbour, McKenzie et al. 1998; and Karumba, Qld Dept Primary Industries 1999).

Annual changes in seagrass biomass were uneven over the survey regions. Most losses (between 1995 and 1998) were in parts of the northern sub-tidal region distant from Oyster Point; the northern intertidal region close to Oyster Point; and the southern intertidal region distant from Oyster Point. Overall, declines in the northern and southern survey regions between 1995 and 1998 were reversed in 1999.

Seagrass biomass in the silt-affected area in 1998 (Lee Long et al. 1999) was not significantly different to biomass immediately near-by, but plants showed signs of recent burial and were beginning to lose chlorophyll coloration on their buried parts. Prolonged direct burial by silt has potential to kill seagrasses, but in December 1999 there was far less silt present and seagrass distribution and biomass had recovered.

The year-to-year changes in biomass at Oyster Point between November 1995 and December 1999 are mostly within the expected background ranges of variability for these seagrass species.

Light is one of the most important factors influencing growth and survival of seagrasses and year-to-year changes in meteorological conditions alone could explain much of the changes in seagrass biomass. The Sinclair Knight Merz turbidity monitoring program spanning one hundred days in 1997 established that wind-driven turbidity patterns masked any dredging-related turbidity plumes except on two days of calm clear water (Sinclair Knight Merz, 1998). Wind alone is probably the dominant influencing factor on water turbidity at Oyster Point and year-to-year changes in cloud and wind would mask possible impacts of the dredging program.

An increase in seagrass biomass in December 1999, corresponded with a decrease in the number of strong-wind days and cloudy days, and could be explained by an increase in the total light budget available for seagrass growth in the 1999 sampling season.

The increase in eastern sector winds from the 1995 sampling season to the 1997 sampling season was coincident with a decline in seagrass biomass in these parts of the survey region. Additional increases in cloud cover in 1998 could also explain further declines in seagrass abundance over most regions. Subsequent decreases in wind and cloud in the 1999 sampling season are coincident with increases in seagrass biomass and distribution.