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The Effects on Waterbirds of Dredging at the Cardiff Bay Barrage Report for 2005/06

Authors

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EXECUTIVE SUMMARY

1. This study reports the impact of maintenance dredging on the birds utilising mudflats within and adjoining the outer harbour of the Cardiff Bay barrage using data collected in January and March 2006. Results are compared to those reported between 2002 and 2005. Dredging is required to maintain a channel from the outer harbour to the sea and to prevent sediment build up within this harbour. Initial dredging took place during the construction of the barrage and since August 2000 has usually taken place twice annually (in February and August). During the period of study, mudflats were dredged between 4 and 20 February 2006. Within the outer harbour, mudflats reform naturally after dredging.

2. Cardiff Bay was formed by the combined estuaries of the Rivers Taff and Ely and is situated at the mouth of the larger Severn Estuary. The bay was impounded by a barrage constructed at its mouth in November 1999. The mudflats that now adjoin the Cardiff Bay barrage historically formed part of the intertidal mudflats of the bay.

3. Data are presented for the months of January 2006, before dredging commenced, and March 2006, after dredging operations had been completed.

4. Eleven waterbird species were recorded using the mudflats affected by dredging in January and March 2006. These included four of the 10 species of wildfowl and wader that had been recorded on the equivalent mudflats prior to barrage construction – Shelduck, Mallard, Curlew and Redshank – together with Cormorant, Mute Swan and five species of gull – Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull. These species, and also Oystercatcher had been recorded on these mudflats during previous periods of post-barrage fieldwork.

5. By far the most numerous species on the mudflats affected by dredging were Black-headed Gull and Lesser Black-backed Gull. Aside from these, only Cormorant, Herring Gull and Mallard were recorded in numbers of greater than 10 on any one of these mudflats. Black-headed, Lesser Black-backed and Herring Gulls utilised all three mudflat areas, whilst Mallard particularly favoured the area within the outer harbour. These results are very similar to those reported previously.

6. Although the overall numbers of wildfowl and waders using the mudflats affected by dredging are very low, two species found on these mudflats – Mute Swan and Redshank – were not recorded on comparative areas of mudflat nearby. Densities of Black-headed, Lesser Black-backed and Herring Gulls were greater on the comparative mudflats, however.

7. There is some evidence that the dredging in February 2006 may have had an effect in the short term, as numbers of both Mallard and Black-headed Gull fell on the mudflats by the barrage. However, there were slight increases in the numbers of Cormorants and Herring Gulls following the operations and Mute Swan and Shelduck were only recorded on these mudflats in March.

8. Over the longer-term (i.e. the five years of monitoring), numbers of Black-headed Gull have declined on the mudflats affected by dredging, while remaining stable on adjacent mudflats. Herring Gull numbers have also remained stable on the mudflats affected by dredging, while they have increased on the adjacent mudflats. This might suggest that the regular dredging that has occurred since the barrage was completed has prevented invertebrate food supplies from developing – if so, this would be an inevitable consequence of complying with the statutory requirements of the Cardiff Bay Barrage Act 1993. However, it is notable that numbers of Mallard have actually increased on these mudflats over the same period. It is perhaps more likely, therefore, that gull numbers have been reduced due to disturbance from people on the barrage – Mallard being more tolerant of human activity.

9. Densities of wader and wildfowl species on the mudflats affected by dredging are lower than those found prior to construction of the barrage and this may in part be due to disturbance. Overall, the numbers of birds that might be affected by dredging are very small in relation to the substantial populations found locally.

10. Further monitoring is recommended in order to allow future assessment of the impacts of dredging over both the short and long term.

1. INTRODUCTION

This study reports the impact of maintenance dredging on the birds utilising mudflats within and adjoining the outer harbour of the Cardiff Bay barrage using data collected in January and March 2006. Dredging is required to maintain a channel from the outer harbour to the sea and to prevent sediment build up within the harbour. Within the outer harbour, mudflats reform naturally after dredging. Initial dredging took place during the construction of the barrage and since August 2000 has usually taken place twice annually (in February and August). During the period of study, mudflats were dredged between 4 and 20 February 2006.

Data are presented separately for periods immediately before and after dredging, in January and March 2006, so as to assess whether there were any short-term impacts of the operations. Longer-term impacts are assessed through comparison with the data contained in previous reports (Burton & Clark 2002a, 2002b, Burton *et al.* 2003a, 2003b, 2005, Holloway *et al.* 2004).

The ornithological significance of the mudflats by the barrage was assessed in previous reports (Burton & Clark 2002a, 2002b) by comparing counts made between August 2001 and March 2002 with historic data collected prior to the construction of the barrage and with concurrent count data from two adjacent areas of mudflat.

Cardiff Bay was formed by the combined estuaries of the Rivers Taff and Ely and is situated at the mouth of the larger Severn Estuary. The bay was impounded by a barrage constructed at its mouth in November 1999. The Severn Estuary is ornithologically important because of the populations of waterbirds (i.e. grebes, cormorants, herons, rails, wildfowl, waders, gulls and terns) that it supports in winter and as a result is designated as a Special Protection Area (SPA). Some of the mudflats beside the Cardiff Bay barrage are included in this area.

The Severn Estuary currently holds internationally important numbers of Shelduck *Tadorna tadorna*, Teal *Anas crecca*, Pintail *A. acuta*, Dunlin *Calidris alpina* and Redshank *Tringa totanus* (Collier *et al.* 2005) and Cardiff Bay itself formerly held nationally important numbers of Dunlin (Burton *et al.* 2003c). Sites are considered internationally important for a species if they regularly hold at least 1% of the individuals in a population of that species. Sites within Britain are considered nationally important for a species if they regularly hold 1% or more of the estimated British population of that species. Current national importance thresholds for the waterbird species referred to in this report are shown in Appendix 1.

2. METHODS

Figure 2.1 shows the areas subject to maintenance dredging and Figure 2.2, the numbered mudflat count areas that have been surveyed between August 2001 and March 2006. Areas B2 and B3 include remnants of the mudflats of the bay that were dissected by the building of the barrage. Accretion of sediments has enlarged these mudflats and also occurs naturally within the barrage's outer harbour – 'mudflat' B5. This area would also previously have formed part of the bay's intertidal area. Dredging of these three mudflats is required to allow continued passage of boats from the barrage gates to the sea. Two further areas of mudflat – areas B1 and B4 – were also surveyed to provide comparative counts. Mudflat B1 was similar to B2, both being entirely muddy, whilst mudflats B3 and B4 contained a mix of mud and rocky substrate. The five mudflats are, respectively, 4.8, 11.9, 7.0, 19.8 and 3.3 ha in size at mean low tide.

The waterbirds using mudflats B1-B5 were counted at hourly intervals (relative to low tide) over the time that the mudflats were exposed, twice in both January and March 2006. Counts were undertaken on 28-30 January and 11-13 March. The mudflats became exposed around 3 hours before low tide and became inundated around 3 hours afterwards. The counts made in January were before dredging took place, whilst those in March were made after dredging operations had finished.

Counts of area B5 within the barrage's outer harbour included birds on the water and on the small area of mudflat that formed at low tide.

The mean numbers and densities of waterbirds recorded on mudflats B1-B5 at low tide are tabulated for both January and March. Further tables provide information on the mean bird hours recorded per tidal cycle (i.e. the sum of the average number of birds each hour) on mudflats B1-B5 and the peak numbers of each species recorded on each mudflat. By tabulating the data in this way, it is possible to assess whether the numbers of birds occurring on the mudflats after dredging differed from those that occurred prior to operations.

The longer term effects of dredging were considered by looking for trends in waterbird numbers since monitoring began in 2001/02. Analyses were only undertaken for those species which had ever been recorded on the mudflats affected by dredging in numbers of greater than 10, i.e. Cormorant *Phalacrocorax carbo*, Mallard *Anas platyrhynchos*, Black-headed Gull *Larus ridibundus*, Lesser Black-backed Gull *L. fuscus* and Herring Gull *L. argentatus*.

For each of these species, generalized linear models (GLMs) were used to relate the density of feeding birds on each count (birds/ha) to the year, period (pre-dredging or post-dredging), state of tide (hour relative to low water at which the count was undertaken) and the mudflat count area. Models assumed a Poisson distribution and a log link function, used the natural logarithm of mudflat area (ha) as an offset and the PSCALE option to account for overdispersion (SAS Institute Inc. 1999-2001), and treated period, state of tide and mudflat as class variables. Pre-dredging counts used in the analyses were undertaken in January in each of the five years of monitoring; post-dredging counts were undertaken either in late February or early March. Analyses were undertaken separately for the mudflats affected by dredging (B2, B3 and B5) and those not (B1 and B4). Trends were considered significant if the year factor in the model had a P value of less than 0.05.

3. RESULTS

Table 3.1 reports the mean numbers and densities of waterbirds recorded on mudflats B1-B5 at low tide in January and March 2006. Table 3.2 indicates the overall usage of mudflats B1-B5 through the tidal cycle and Table 3.3, the peak numbers of birds recorded on each mudflat.

A total of 11 waterbird species were recorded using the mudflats affected by dredging, i.e. B2, B3 and B5, in January and March 2006. These included five species of wildfowl and wader – Mute Swan *Cygnus olor,* Shelduck*,* Mallard, Curlew *Numenius arquata* and Redshank – and in addition, Cormorant*,* and five species of gull – Black-headed Gull, Common Gull *Larus canus*, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull *L. marinus*.

By far the most numerous species on the mudflats affected by dredging were Black-headed Gull and Lesser Black-backed Gull. Aside from these, only Cormorant, Herring Gull and Mallard were recorded in numbers of greater than 10 on any one of these mudflats (Table 3.3). Tables 3.1 and 3.3 show that Black-headed, Lesser Black-backed and Herring Gulls utilised all three mudflats, whilst Mallard particularly favoured mudflat B5, within the outer harbour. The latter mudflat was also used by Cormorants, Redshank and all five species of gull.

Gulls were particularly associated with the channel and seaward edge of mudflats, whilst other species were found higher up the mudflats. Typically, the overwhelming majority of the birds that were recorded on these mudflats were feeding.

Table 3.1 also allows comparison to be made between the low tide densities found on the mudflats affected by the dredging (B2, B3 & B5) and those found on mudflats B1 and B4, which have not been affected by dredging. In comparison to mudflats B2, B3 and B5, mudflats B1 and B4 held higher low tide densities of Black-headed, Lesser Black-backed and Herring Gulls. In contrast, no Mallard or Redshank were recorded on mudflats B1 or B4.

The possible short term effects of dredging can be examined by comparing the numbers of birds recorded in January 2006 (pre-dredging) with those in March 2006 (post-dredging). On the mudflats affected by operations, numbers of both Mallard and Black-headed Gull were lower following the dredging in February 2006. In contrast, there were slight increases in the numbers of Cormorants and Herring Gulls following the operations. Mute Swan and Shelduck were only recorded on these mudflats in March.

Over the longer term, numbers of Mallard have shown a small, but significant increase on the mudflats affected by dredging ($F_{1,304}$ = 6.39, P = 0.0120). Mallard only rarely used the other mudflats monitored. In contrast, over the same five year period, numbers of Black-headed Gulls have decreased on the mudflats affected by dredging ($F_{1,304}$ = 35.84, $P < 0.0001$) while showing no trend on the adjacent mudflats ($F_{1,204}$ = 2.91, P = 0.0895). Numbers of Cormorant (CA) and Lesser Black-backed Gull (LB) have shown no trend on both the mudflats affected by dredging (CA: $F_{1,304}$ = 1.58, P = 0.2095; LB: $F_{1,304}$ = 0.09, P = 0.7590) and those not (CA: $F_{1,204}$ = 0.19, P = 0.6618; LB: $F_{1,204}$ = 1.38, P = 0.2422). Herring Gull numbers also showed no trend on the mudflats affected by dredging ($F_{1,304}$ = 1.42, P = 0.2350), but increased on adjacent mudflats ($F_{1,204}$ = 7.22, P = 0.0078).

4. ASSESSMENT OF THE ORNITHOLOGICAL IMPORTANCE OF THE STUDY AREA AND THE POTENTIAL IMPACT OF DREDGING

A total of 11 waterbird species were recorded using the mudflats affected by dredging, i.e. B2, B3 and B5, in January and March 2006. These included four species of wildfowl and wader that had been recorded on the equivalent mudflats prior to barrage construction (Burton & Clark 2002a, 2002b) – Shelduck, Mallard, Curlew and Redshank. In addition, Cormorant, Mute Swan and five species of gull – Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull were also recorded on these mudflats. These species, and also Oystercatcher *Haematopus ostralegus* had been recorded on these mudflats during previous fieldwork (Burton *et al.* 2005).

The report for 2001/02 found that the densities of Shelduck, Mallard, Oystercatcher, Curlew and Redshank were less than those found in the four years immediately prior to construction of the barrage and that five species of wildfowl and wader recorded in those years were absent (Burton & Clark 2002b). However, though the overall numbers of wildfowl and waders using the mudflats affected by dredging are now very low, two species found on these mudflats in January / March 2006 – Mallard and Redshank – were not recorded on comparative areas of mudflat nearby. Densities of Black-headed, Lesser Black-backed and Herring Gulls were greater on the comparative mudflats, however. These findings are similar to those of August 2001 to March 2006 (Burton & Clark 2002a, 2002b, Burton *et al.* 2003a, 2003b, 2005, Holloway *et al.* 2004).

The reports for previous winters found only slight evidence that densities of waterbirds might have been affected by dredging operations in the short term. For example, in 2004 and 2003, numbers of Black-headed and Lesser Black-backed Gulls decreased after dredging in February. Although, for gulls this may have been because some of the birds were beginning to move back to their breeding areas, it is also possible that declines in waterbird numbers in those years were linked to a short-term decline in food resources, possibly as a result of dredging disturbance. However, as the levels of the food resources in the water and sediments were not measured, it is not possible to say for sure. In 2005, there was no evidence that the dredging had any effects in the short-term; indeed numbers of Black-headed, Lesser Black-backed and Herring Gulls were all higher following the operations than beforehand.

This winter, numbers of both Mallard and Black-headed Gull fell following dredging, again suggesting that dredging may have had an effect in the short-term. However, it is probable that the numbers of these species were also reduced on the mudflats beside the barrage by the high winds that were prevalent on one day of the March 2006 counts. Among other species, there were slight increases in the numbers of Cormorants and Herring Gulls following the operations and Mute Swan and Shelduck were only recorded on these mudflats in March.

Over the five years of monitoring, numbers of Black-headed Gull – the most numerous species in the area – have declined on the mudflats affected by dredging, while remaining stable on adjacent mudflats. Additionally, although Herring Gull numbers have remained stable on the mudflats affected by dredging, they have increased on the adjacent mudflats. This would perhaps suggest that dredging might have had an effect in the longer term. Due to the regular dredging that has occurred since the barrage was completed invertebrate food supplies may have been prevented from developing in some areas. If so, this would be an inevitable consequence of complying with the statutory requirements of the Cardiff Bay Barrage Act 1993. However, it is also possible that numbers of these species have been affected by disturbance from people on the barrage. It is notable that numbers of Mallard, a species which is often tolerant of man's activities, have actually increased on the mudflats affected by dredging and this would suggest that waterbird food supplies might not have been affected by the operations.

As reported previously, densities of wader and wildfowl species on the mudflats affected by dredging are lower than those found prior to construction of the barrage (Burton & Clark 2002b) and this may in

part be due to disturbance. Overall, the numbers of birds that might be affected by dredging are very small in relation to the substantial populations found locally (see Burton *et al.* 2003c).

Further monitoring is recommended in order to allow future assessment of the impacts of dredging over both the short and long term.

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	Jan 2006		Mar 2006	
	n	d	n	d
Cormorant				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	0	0
Mudflat B5	0.5	0.15	0	0
Mudflat B1	0	0	1.5	0.31
Mudflat B4	0	0	0	0
Mudflats B2,B3,B5	**0.5**	**0.02**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**1.5**	**0.06**
Mute Swan				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	0	0
Mudflat B5	0	0	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0	0	0	0
Mudflats B2,B3,B5	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**0**	**0**
Shelduck				
Mudflat B2	0	0	2.5	0.21
Mudflat B3	0	0	0	0
Mudflat B5	0	0	0	0
Mudflat B1	0.5	0.10	1.5	0.31
Mudflat B4	2	0.10	1.0	0.05
Mudflats B2,B3,B5	**0**	**0**	**2.5**	**0.11**
Mudflats B1, B4	**2.5**	**0.10**	**2.5**	**0.10**
Mallard				
Mudflat B2	0	0	0	0
Mudflat B3	4	0.57	0	0
Mudflat B5	5	1.52	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0	0	0	0
Mudflats B2,B3,B5	**9**	**0.41**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**0**	**0**
Oystercatcher				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	0	0
Mudflat B5	0	0	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0	0	0.5	0.03
Mudflats B2,B3,B5	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**0.5**	**0.02**
Curlew				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	0	0
Mudflat B5	0	0	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0.5	0.03	0	0
Mudflats B2,B3,B5	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0.5**	**0.02**	**0**	**0**

Table 3.1 Mean low tide numbers (n) and densities (d) (birds/ha) of waterbirds using mudflats near the Cardiff Bay barrage at low tide in January and March 2006.

Only species recorded since August 2001 at low tide on mudflats affected by dredging (shown italicised) are included. Figures in bold are total numbers and densities for mudflats B2, B3 and B5 combined and for mudflats B1 and B4 combined.

	Jan 2006		Mar 2006	
	n	d	n	d
Redshank				
Mudflat B2	2.0	0.17	2.0	0.17
Mudflat B3	0	0	0	0
Mudflat B5	0	0	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0	0	0	0
Mudflats B2,B3,B5	**2.0**	**0.09**	**2.0**	**0.09**
Mudflats B1, B4	**0**	**0**	**0**	**0**
Black-headed Gull				
Mudflat B2	0.5	0.04	1.0	0.08
Mudflat B3	1.5	0.21	0.5	0.07
Mudflat B5	10.5	3.18	1.5	0.45
Mudflat B1	1.0	0.21	0	0
Mudflat B4	84.0	4.24	26.5	1.34
Mudflats B2,B3,B5	**12.5**	**0.56**	**3.0**	**0.14**
Mudflats B1, B4	**85.0**	**3.46**	**26.5**	**1.08**
Common Gull				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	0	0
Mudflat B5	1.0	0.03	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0	0	2.0	0.10
Mudflats B2,B3,B5	**1.0**	**0.05**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**2.0**	**0.08**
Lesser Black-backed Gull				
Mudflat B2	2.5	0.21	1.5	0.13
Mudflat B3	0	0	0	0
Mudflat B5	2.5	0.76	4.5	1.36
Mudflat B1	1.0	0.21	2.5	0.52
Mudflat B4	55.5	2.80	16.5	0.83
Mudflats B2,B3,B5	**5.0**	**0.23**	**6.0**	**0.27**
Mudflats B1, B4	**56.5**	**2.30**	**19.0**	**0.77**
Herring Gull				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	2.0	0.29
Mudflat B5	0	0	1.5	0.45
Mudflat B1	0	0	0	0
Mudflat B4	20.5	1.04	18.5	0.93
Mudflats B2,B3,B5	**0**	**0**	**3.5**	**0.16**
Mudflats B1, B4	**20.5**	**0.83**	**18.5**	**0.75**
Great Black-backed Gull				
Mudflat B2	0	0	0	0
Mudflat B3	0	0	0	0
Mudflat B5	0	0	0	0
Mudflat B1	0	0	0	0
Mudflat B4	0	0	1.0	0.05
Mudflats B2,B3,B5	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**1.0**	**0.04**

Table 3.1 Continued.

	Jan 2006	Mar 2006
Cormorant		
Mudflat B2	2.5	35.5
Mudflat B3	0	0
Mudflat B5	0.5	0
Mudflat B1	3.0	6.5
Mudflat B4	0	0.5
Mute Swan		
Mudflat B2	0	0.5
Mudflat B3	0	0
Mudflat B5	0	0
Mudflat B1	0	0
Mudflat B4	0	0
Shelduck		
Mudflat B2	0	6.5
Mudflat B3	0	1.0
Mudflat B5	0	0
Mudflat B1	3.0	17.0
Mudflat B4	5.0	7.0
Mallard		
Mudflat B2	0	0
Mudflat B3	4.0	0
Mudflat B5	94.0	2.5
Mudflat B1	0	0
Mudflat B4	0	0
Oystercatcher		
Mudflat B2	0	0
Mudflat B3	0	0
Mudflat B5	0	0
Mudflat B1	0	0
Mudflat B4	0.5	1.0
Curlew		
Mudflat B2	0	0
Mudflat B3	1.0	0
Mudflat B5	0	0
Mudflat B1	0	0
Mudflat B4	9.5	0.5
Redshank		
Mudflat B2	16.5	8.0
Mudflat B3	0	0
Mudflat B5	0.5	0.5
Mudflat B1	0	0
Mudflat B4	0	0

Table 3.2 Mean numbers of bird hours per tidal cycle recorded on mudflats near the Cardiff Bay barrage in January and March 2006.

Only species recorded since August 2001 on mudflats affected by dredging (shown italicised) are included.

	Jan 2006	Mar 2006
Black-headed Gull		
Mudflat B2	68.0	30.0
Mudflat B3	18.5	7.0
Mudflat B5	78.5	12.0
Mudflat B1	39.0	10.0
Mudflat B4	286.0	117.0
Common Gull		
Mudflat B2	0.5	0
Mudflat B3	0	0
Mudflat B5	2.0	0
Mudflat B1	0	0.5
Mudflat B4	2.0	11.5
Lesser Black-backed Gull		
Mudflat B2	30.5	4.0
Mudflat B3	5.0	13.0
Mudflat B5	11.0	18.0
Mudflat B1	14.0	6.0
Mudflat B4	310.5	71.0
Herring Gull		
Mudflat B2	4.0	3.0
Mudflat B3	6.5	14.0
Mudflat B5	0.5	6.0
Mudflat B1	0.5	8.0
Mudflat B4	68.0	92.5
Great Black-backed Gull		
Mudflat B2	1.0	0.5
Mudflat B3	0	0.5
Mudflat B5	0	0.5
Mudflat B1	0	0
Mudflat B4	2.0	3.0

Table 3.2 Continued.

	Jan 2006	Mar 2006
Cormorant		
Mudflat B2	2	15
Mudflat B3	0	0
Mudflat B5	1	0
Mudflat B1	2	2
Mudflat B4	0	1
Mute Swan		
Mudflat B2	0	1
Mudflat B3	0	0
Mudflat B5	0	0
Mudflat B1	0	0
Mudflat B4	0	0
Shelduck		
Mudflat B2	0	4
Mudflat B3	0	2
Mudflat B5	0	0
Mudflat B1	3	17
Mudflat B4	6	12
Mallard		
Mudflat B2	0	0
Mudflat B3	8	0
Mudflat B5	32	3
Mudflat B1	0	0
Mudflat B4	0	0
Oystercatcher		
Mudflat B2	0	0
Mudflat B3	0	0
Mudflat B5	0	0
Mudflat B1	0	0
Mudflat B4	1	1
Curlew		
Mudflat B2	0	0
Mudflat B3	2	0
Mudflat B5	0	0
Mudflat B1	0	0
Mudflat B4	7	1
Redshank		
Mudflat B2	5	5
Mudflat B3	0	0
Mudflat B5	1	1
Mudflat B1	0	0
Mudflat B4	0	0

Table 3.3 Peak numbers of waterbirds recorded on mudflats near the Cardiff Bay barrage in January and March 2006.

Only species recorded since August 2001 on mudflats affected by dredging (shown italicised) are included.

	Jan 2006	Mar 2006
Black-headed Gull		
Mudflat B2	44	37
Mudflat B3	55	7
Mudflat B5	47	7
Mudflat B1	72	16
Mudflat B4	121	80
Common Gull		
Mudflat B2	1	0
Mudflat B3	0	0
Mudflat B5	2	0
Mudflat B1	0	1
Mudflat B4	4	6
Lesser Black-backed Gull		
Mudflat B2	17	3
Mudflat B3	6	16
Mudflat B5	5	12
Mudflat B1	10	4
Mudflat B4	81	25
Herring Gull		
Mudflat B2	4	4
Mudflat B3	6	11
Mudflat B5	1	5
Mudflat B1	1	8
Mudflat B4	26	35
Great Black-backed Gull		
Mudflat B2	1	1
Mudflat B3	0	1
Mudflat B5	0	1
Mudflat B1	0	0
Mudflat B4	2	2

Table 3.3 Continued.

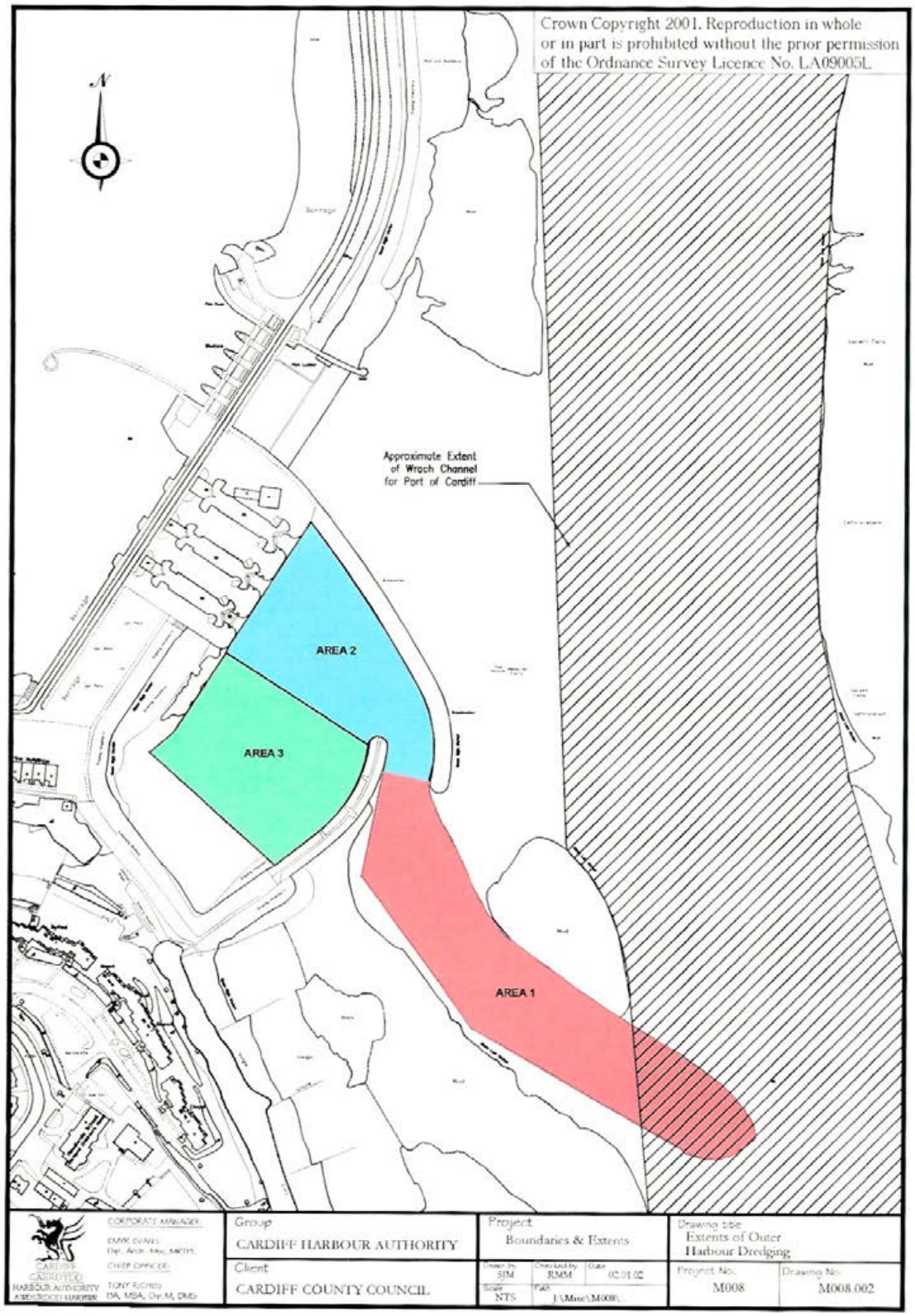

Figure 2.1 The Cardiff Bay barrage showing areas (shaded grey) subject to maintenance dredging.

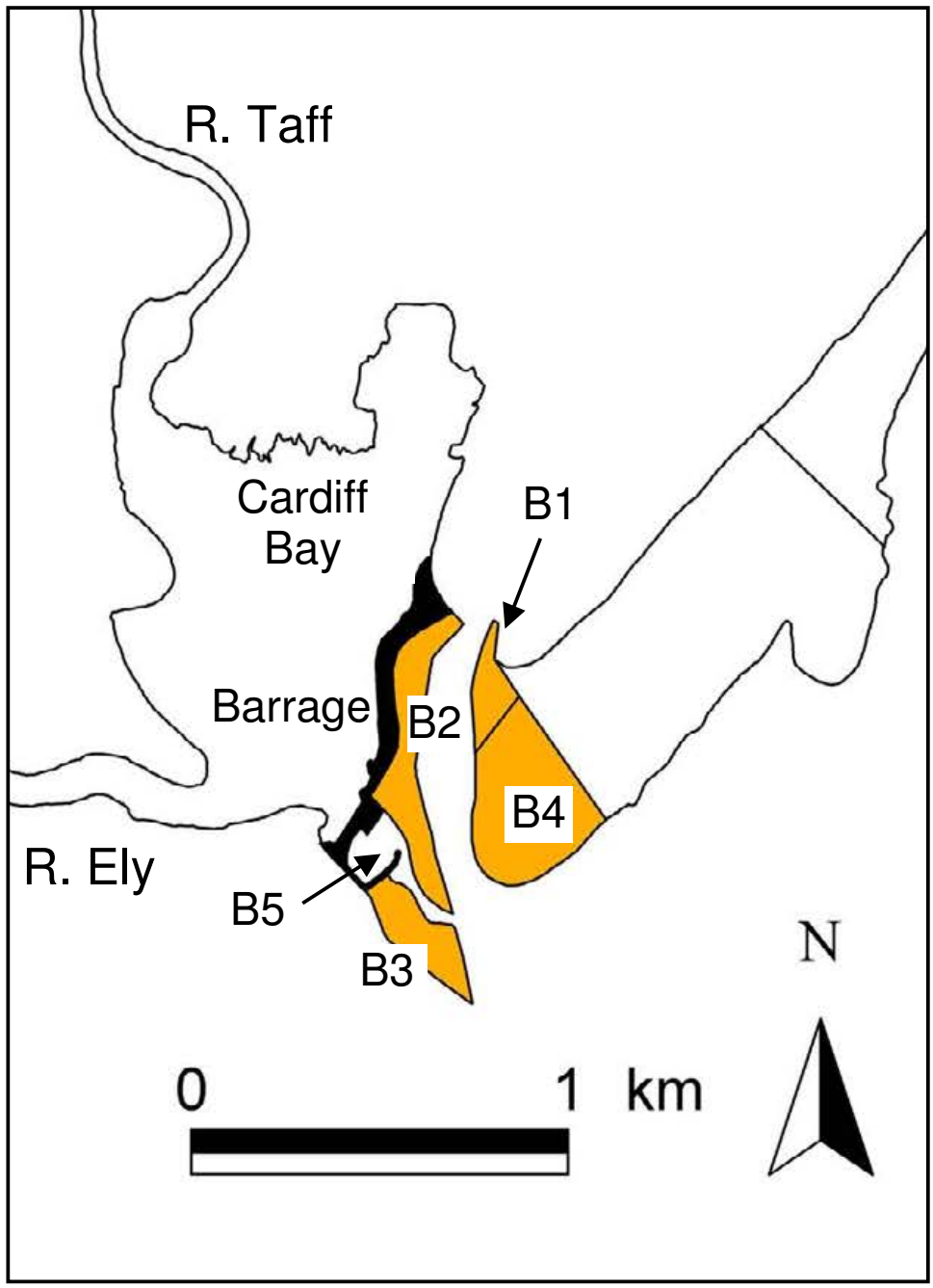

Figure 2.2 The Cardiff Bay barrage showing numbered mudflat count areas (shaded) monitored between August 2001 and March 2006.

Appendix 1 National importance thresholds for waterbird species referred to in this report (taken from Collier *et al.* 2005).

Cormorant *Phalacrocorax carbo*	230
Mute Swan *Cygnus olor*	375
Shelduck *Tadorna tadorna*	782
Teal *Anas crecca*	1,920
Mallard *Anas platyrhynchos*	3,520
Pintail *Anas acuta*	279
Oystercatcher *Haematopus ostralegus*	3,200
Dunlin *Calidris alpina*	5,600
Curlew *Numenius arquata*	1,500
Redshank *Tringa totanus*	1,200
Black-headed Gull *Larus ridibundus*	19,000
Common Gull *Larus canus*	9,000
Lesser Black-backed Gull *Larus fuscus*	500
Herring Gull *Larus argentatus*	4,500
Great Black-backed Gull *Larus marinus*	400