

Summary

- *Overview*

Dredging has been undertaken in the lower Thames between Hurley and Teddington since the late 1940s to maintain a navigable channel and to manage flood risk by maintaining the channel flow capacity. However, dredging can be environmentally destructive and cause the direct loss of habitat and the suffocation of riverine populations downstream. The sustainability of continuously removing sediment from the river is also questionable as the sediment system is always in flux and rivers may *self-scour* during flood events. There is uncertainty surrounding the extent to which this self-scouring mechanism removes sediment.

Since 1997 full channel dredging has ceased and now only isolated shoals are dredged for navigation purposes. As a result there is concern that bed levels have increased since 1997 reducing the flow capacity of the river channel. The Environment Agency has a statutory duty to maintain public rights of navigation, is the body that provides flood protection and also has a legal duty to further nature conservation. It is therefore important that any future dredging strategy is well-informed and takes into account the long-term trends in bed levels, the natural sedimentation and scouring regime of the river, and the costs and practicality of dredging and disposal of the waste. Further guidance on sediment removal from rivers is provided in the Environment Agency Briefing Note 1988469 'Channel Maintenance', 2008.

Under the Water Framework Directive, dredging of the Lower Thames will only be permitted if it can be shown to be absolutely necessary. Unless it can be shown that dredging will not prevent the Thames from reaching good ecological status, or at least good ecological potential (assuming it is classed as a heavily modified watercourse), dredging may only be permitted through a derogation that demonstrates beyond reasonable doubt that dredging is essential to the public good and that sediment constitutes nuisance. It will also be necessary to demonstrate that there is no alternative management strategy to dredging and that it will be undertaken in the least environmentally damaging manner.

Here, an assessment of the baseline situation is presented to inform decisions on the extent of any future dredging. This report reviews dredging records and sediment datasets; analyses hydrographic surveys of the river bed; presents results

from mathematical modelling of the sediment system during flood events; and summarises the costs of dredging and disposal options.

- *Previous studies*

Dredging of the lower Thames has been investigated previously as part of the Lower Thames Strategy (Halcrow Group Ltd) and for the Dredging Analysis in 1998-2000 (Mott MacDonald). In addition to these studies, data describing sediment concentrations and composition has been collected by the Maidenhead Morphological Study 1988 (H.R. Wallingford). The key findings of these studies are reviewed in this report and copies of the summaries of these study reports are included in Appendix A of this report.

- *Historic dredging*

Dredging records alone cannot be used to assess sedimentation rates since the volume of dredging undertaken is dependent on factors other than sedimentation such as the perceived flood risk and maintenance budgets. Records of dredging have not been kept systematically but have been previously collated in the scoping phase of the Thames Dredging Study of 1998 (Mott MacDonald). Historically the annual volume dredged has varied between around 15,000 to 73,000 tonnes per annum on average, for the whole of the lower Thames. Since 1997 the volume dredged is significantly lower. However, it has not been possible to obtain reliable records of current volumes.

- *Nature of sediment*

Data describing both bed material and suspended sediment in the lower Thames are reviewed. Bed material samples have been collected from over 50 locations as part of numerous past studies and all show a similar range of bed material composition of sandy gravel. Bathymetric surveys undertaken for two reaches in 2008 (Old Windsor and Bell Weir), supported by a limited number of physical samples, have provided more detailed mapping of the bed material density, confirming the bed material in these reaches is predominantly gravel sized. Information for suspended sediment composition and concentrations is much more limited with only a few samples available.

- *Hydrographic surveys*

Hydrographic data for a 15 year period have been analysed to assess the changes in bed levels over this time period for each reach. Table 1-1 below summarises the net changes recorded in the total reach bed volumes and the corresponding average change in bed level over the reach between successive surveys.

Results are variable within and across reaches with both net deposition and erosion occurring in the periods between surveys and there is no apparent systematic long term trend of sedimentation that is consistent between reaches. Within each sub-reach the pattern of erosion and deposition varies and significant local depositions are recorded in some reaches where the overall net change in reach volume indicates erosion.

The recorded changes in bed volume and levels also depend on the timing of the surveys in relation to periods of high and low river flow. Net changes in bed volumes of up to around 100,000 m³ have been recorded between surveys in some sub-reaches. The recorded annual average net volume changes are typically in the range 10,000 m³ to 20,000 m³ per year in each sub-reach although larger transient variations may be masked for the longer survey intervals. This is many times larger than the volume currently dredged for the entire lower Thames. The change in average bed level recorded between surveys is generally within the range of +/- 300mm with annual average changes typically in the range of +/-100mm per year. However, local changes in excess of +/-500mm have been recorded.

Reach	Change in river bed	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Teddington	Net volume (cu m)							-65,541					-98,645			
	Average level (m)							-0.13					-0.19			
Molesey	Net volume (cu m)												-101,023			
	Average level (m)												-0.27			
Sunbury	Net volume (cu m)												-100,190			
	Average level (m)												-0.27			
Shepperton	Net volume (cu m)							41,956					-58,619			
	Average level (m)							0.23					-0.33			
Chertsey	Net volume (cu m)							-12,233					-18,856			
	Average level (m)							-0.07					-0.11			
Penton Hook	Net volume (cu m)												70,003			-97,681
	Average level (m)												0.31			-0.49
Bell Weir	Net volume (cu m)							-9,384					57,503			-56,577
	Average level (m)							-0.04					0.25			-0.30
Old Windsor	Net volume (cu m)									11,461		-35,955		35,246		-33,446
	Average level (m)									0.05		-0.15		0.16		-0.20
Romney	Net volume (cu m)							-18,343							-48,492	
	Average level (m)							-0.10							-0.28	
Boveney	Net volume (cu m)												-91,811			
	Average level (m)												-0.36			
Bray	Net volume (cu m)							57,700							-39,791	
	Average level (m)							0.32							-0.22	
Boulters	Net volume (cu m)										-40,614				-42,379	
	Average level (m)										-0.22				-0.23	
Cookham	Net volume (cu m)							28,406								
	Average level (m)							0.07								
Marlow	Net volume (cu m)												-48,218			
	Average level (m)												-0.29			
Temple	Net volume (cu m)							-8,743							-33,170	
	Average level (m)							-0.08							-0.29	

Values in blue indicate net erosion for reach
Values in red indicate net deposition for reach

Table 1-1: Summary of river bed changes from bathymetric surveys

- *Sediment modelling*

Modelling of sediment transport during flood flows has been undertaken to investigate the extent of self-scouring in the river under low return period flood events. The results of the model simulations have been found to be relatively sensitive to the bed material type and suspended sediment concentration specified in the model, for which little reliable data are available. For fine grained bed material, the model results suggest it is likely that the majority of the river will self scour during 5%-50% annual probability flood events. For a coarser bed material the model results suggest that self-scouring of the river as a whole is less likely and may be limited to certain sub-reaches. Flood scouring may therefore be limited to particular sub-reaches and isolated areas of sand-sized bed material.

The modelling suggests that depths of erosion and deposition during a flood event vary significantly along a reach and are influenced by local variations in channel shape and bed level, velocity and the presence of structures. The model results indicate that even for sub-reaches where net erosion is predicted, local areas of deposition can still occur.

- *Cost of dredging*

Potential costs of dredging have been collated. Cost estimates for the whole dredging operation range from £15 to £65 per cubic metre of dredged material. Although disposal has become more difficult under new waste legislation and with the closure of the main disposal site (Penton Hook Pit), various alternative disposal options are available.

- *Consultation*

Environment Agency staff representing all the functions of the Agency in relation to the River Thames have been consulted regarding the risks associated with alternative dredging strategies. There is particular concern for the impact of dredging on water quality (with regard to both riverine animal species and water resource abstractions), river geomorphology with regard to habitat destruction, bank stability and damage to structures. The main concern raised over discontinuing dredging is the impact on navigation rights. The impact on flood risk is considered to be low by Agency staff.

- *Recommendations*

Recommendations are made for a sediment monitoring programme to improve the evidence base for bed material, suspended sediment composition and suspended sediment concentration. This will enable more reliable sediment modelling to be

undertaken to determine any long term trends in channel bed profiles.
Recommendations are also made for the frequency and method of future
bathymetric surveys to extend the evidence base for actual changes in bed profiles.