7 Management control options

Options appraisal

In order to tackle the issues surrounding sediment management in a holistic way, a Driving Force – Pressure – State – Impact – Response (DPSIR) Framework (Appendix 7) has been developed which considers the wider aspects (Cranfield study, White et al). The DPSIR approach, used interalia by the Organisation for Economic Co-operation and Development (OECD), provides a mechanism for analysing environmental problems. The approach defines the interactions between various parameters and how they inform decisions.

Responses derived from the DPSIR model can be taken as options for local action to reduce sediment loading and can be considered under the following headings:

- **Do nothing**
- **Source control**
  catchment measures; headwater input reduction; bank erosion; tidal inputs; sewage treatment works; algae
- **Dredging**, (ie removal of material from the system)
- **In-channel management techniques** (eg water injection dredging, ploughing, etc)

Whilst these options are considered below, more details concerning the techniques involved are described in Appendix 8, Management Control Techniques.

Do nothing option

Mike Page

Silted up waterbody - Upton Little Broad

If ‘no action’ is the selected sediment management approach, the following consequences can be anticipated:

- Increased siltation leading to loss of safe navigation space, particularly in open waterbodies where siltation rates are higher due to flow conditions, and restrictions within channels.
- Increased siltation leading to loss of habitat.
- Impact on protected landscape, through loss of open water, particularly smaller isolated waterbodies, and the requirement for additional navigation marks to direct traffic through restricted channels.
- Loss of land drainage function/ flow capacity through siltation within channels, leading to increased risk of flooding.
- Serious impact on local economy through decline of boating activity and related tourism businesses.
- Loss of cultural heritage as sailing clubs, boatyards etc close.
- Reduction in boat numbers leading to reduced toll levels, resulting in reduced income for maintenance.
- Eventual equilibration of the system could result in a self-sustaining, although much reduced, channel system.
- Shallower water would limit craft to small, shallow-draughted vessels, such as motor boats or canoes.
- Change to habitats and the wildlife supported.

Conclusion

The Broads are a heavily modified waterway system, which require continued management, to protect people and their livelihoods and wildlife that has adapted to these managed conditions. The ‘do nothing’ option is therefore inappropriate not acceptable, however it might be for some isolated waterbodies.

Source control options

i) **Catchment measures** that will reduce sediment inputs to the water environment either through headwater or internal catchment sources are being developed and implemented on a prioritised basis, through programmes such as Catchment Sensitive Farming and Environmental Stewardship schemes. These programmes have arisen, inter alia through the identified need to reduce diffuse pollution, particularly in terms of nutrients and sediment in order to achieve Government Public Service Agreement and Water Framework Directive targets. Resource protection measures are targeted towards preventing soil loss and are likely to be most effective in decreasing inputs from the headwaters of the Broads. The Broads Authority is working with partners to promote uptake of the schemes both inside and outside the Broads Authority’s executive boundary.

ii) **Bank erosion** is currently tackled strategically, through enforcement of speed limit byelaws, encouragement of low wash hulls etc. However, it can also be dealt with as a point source issue through erosion protection works or rond restoration. These works can be targeted to the high-risk areas identified in the Cranfield desk study (ie where erosion risks are high due to boat numbers or soil type) as well as identified through surveys on the ground.

Soil erosion from field

Natural England

Site-specific works will have an immediate effect on inputs reduction, but the overall effect is likely to be limited due to the high cost of works, and the likely limited amounts that can be achieved at any given time. Both strategic and local measures to reduce boat wash may be successful in the longer term, but they will not be able to address weather conditions or tidally-induced wash and so, used alone, will be an incomplete solution.

iii) **Tidal inputs** are currently unquantified, although believed to be of limited relevance except in the lower reaches of the river system. There is no mechanism to prevent or reduce these inputs that would be cost-effective.

iv) **Sewage treatment works** and industrial discharges provide a source of input into the river system, which could be relatively simply managed. In overall terms however, this is a source of minor significance for sediments per se, but major where nutrient/contaminant inputs impact on water quality.

v) **Point sources** provide a further source of sediment and nutrient inputs to the Broads system, one of the most significant of which is the input of ochre in the Upper Thurne. Implementation of a catchment project in this area would aim to reduce inputs of this material and have a significant local effect.

vi) **Algae/plant material** inputs are currently unquantified, although an MSc research project is investigating this source. However, management works to restore riverbanks by removal of trees and scrub will also impact positively by reducing the quantity of leaf fall into the water. Water quality improvements will reduce algal production and eventually switch the system from an algal to an aquatic plant-dominated state and so reduce the amount of sediment resuspension and hopefully organic material collecting on the bed.

Conclusion

Whilst source control measures undoubtedly represent the most sustainable way to manage sediment, this is unlikely to be achieved in the short term. Further, source controls will neither resolve the current backlog issues nor achieve a nil input situation and so must be used in combination with other options.

Dredging options

R N Flowers

Grab dredging on the River Wensum

Future dredging will be undertaken according to a prioritised programme, following a risk-based assessment, and an agreed design process (see Section 8). Works will be carried out to an agreed waterway specification but will be undertaken on a site-specific basis, within a scenario limited by resources. Dredging specifications allow for a reasonable return period, but at previous siltation rates need to be repeated usually within a 20-year timeframe. Disturbance of the ecology can be an issue locally, and disposal options can also be limited leading to increased transportation or landfilling of material.

Dredging projects need assessment using BESL's hydraulic model. The model is used to test the impact of implementing the waterway specifications to understand possible impacts on salt water entering the freshwater rivers and broads or upstream flooding. Works can also be beneficial by removing contaminants and/or nutrients from the system. Increasing water depth can improve water quality by reducing boat or weather-induced turbidity.

Whilst each project undertaken is also removing part of the sediment backlog and increasing the flood flow capacity of the channel, an effective medium-term campaign is needed to deal with the backlog as a whole.

Conclusion

Whilst dredging is an effective technique for managing sediment, increasing challenges associated with disposal, (such as scarcity of appropriate sites, changing legislation, and landowner consents), are leading to rising costs. In addition, dredging is currently undertaken on a reactive basis. In combination with effective source control, however, the objective is to undertake dredging in a more sustainable, proactive manner, at sufficient levels to remove the backlog from the system. Thereafter, campaigns can be reduced to address annual inputs only.

In-channel management options

Siltation within the Broads does not occur uniformly across the riverbed. River channels scour sediment in areas of high flow and deposit it in areas of low flow, such as the insides of bends. Shoaling or areas of sediment deposition are natural phenomena, however they can have a major impact on navigation by a narrowing of the channel. If dealt with promptly, before shoals compromise the full channel width, then in situ management such as water injection dredging or ploughing could be adopted. These methods can remove material from areas

where it is causing difficulty and redeposit it in areas where the navigation is unaffected eg deep channels or non-navigable channel margins.

Broads Authority

Water injection dredging

Such techniques are generally cost effective as there is no requirement for disposal, but they cannot be used effectively in very shallow areas, areas of low flow unable to redistribute disturbed sediment or where adjacent habitats may be at risk of smothering. In addition, these techniques would require regular reapplication and may also promote greater siltation in downstream sites as the sediment put into suspension gradually settles back on to the bed. As these techniques do not remove sediment, there are no benefits from nutrient removal, and their use would need to be limited to uncontaminated sediment to ensure contamination is not spread to wider areas. A recent trial has been carried out to look at the feasibility of water injection dredging within the Broads, which will enable more comprehensive appraisal of the suitability of this technique. (See Appendix 4)

Conclusion

The application of in-situ treatments in the Broads would provide a low cost option to treat shoaled areas, but the application of such treatment will be restricted to a very few appropriate sites. Water injection dredging as trialled in the Lower Bure has proved to be a very temporary solution, and requires higher flow rates than exist in the majority of the Broads.

Preferred option

From the above options appraisal it can be seen that a combined approach, which considers both short and long-term management will be required. To resolve the issue of the existing backlog within the system it is clear that a combination of dredging and in-channel techniques will be required and the objective should be to attain an achievable and sustainable long-term programme of de-silting. The level of inputs to the system should also be reduced via a combination of measures aimed at each recognised source.

Beneficial reuse

Beneficial reuse is a principle which will be adopted throughout all dredging options and possible options include: habitat creation/restoration; land spreading for agricultural benefit; flood defence works; land raising.

The best projects are those that deliver multiple benefits. Examples of such projects are: working with Hickling Broad Sailing Club to raise land around the club house, habitat creation in the Bure Loop and agricultural benefits at Barton Broad. Working with partners to ensure added value is achieved in all stages of the project and promoting all of the Broads Authority's statutory duties is an important objective of the strategy.

To deliver the aim of reusing material beneficially, a Register of Opportunities will be established. The Disposal/Reuse Action Tables (see Action Plan) are the basis for this register, which will be shared with partner organisations. This will seek to match projects that require materials with suitable dredging projects in the local area. Disposal of dredged material, whether beneficially or via landfilling is complicated and uncertain and the issues are reviewed in Appendix 8.