

APPENDIX E

Option SL3 Supporting Information

- Self Regulating Tidal Flaps and Gates - Extract from *Elver and Eel Passes, A manual for the design and implementation of passage solutions at weirs, tidal gates and sluices*, A.A. Taylor, HO Fisheries, published by The Environment Agency, 01 February 2011.
Available from: <http://publications.environment-agency.gov.uk>
- Dredging Brooklands lake - options memo

7 Self-regulating tidal flaps and gates

Background

In recent years, tidal flaps have been developed that allow controlled tidal intrusion. They allow a degree of tidal interchange and let salt water enter the area draining to the structure, usually for conservation purposes.

Several studies have examined the ecological changes that happen if tidal and salt waters are excluded. See for example Johnston *et al.* (2003), Giannico and Souder (2004) and Kroon and Ansel (2006).

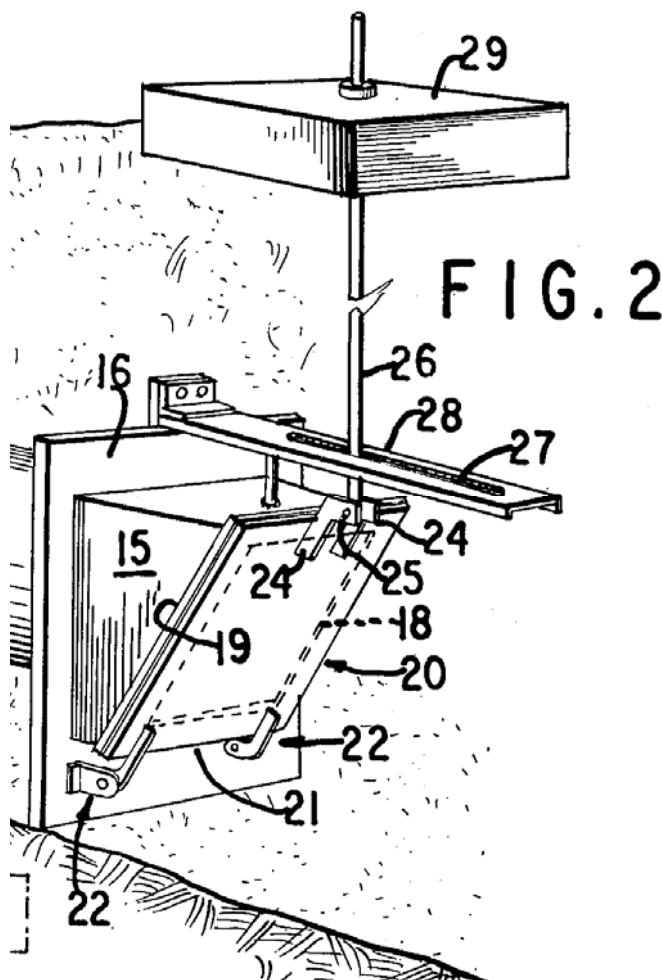


Figure 7.1: Drawing from US Patent 3,974,654, 'Self regulating tide gate', dated 17 August

There is increasing interest in allowing some tidal intrusion into wetlands which are at present cut-off from tidal influence by tidal flaps and gates. Such intrusion is usually referred to as regulated tidal exchange, or RTE. Rupp and Nicholls (2007) published a map showing proposed sites which could benefit from this approach throughout north west Europe. The map included several sites in England and Wales.

Where the gates are under manual or automatic control, the operating regime can be modified to manage RTE. Several self-regulating tidal gates have been developed. These are basically modified tidal flaps that allow RTE without the need for power or supervision. Most designs are fitted with floats which hold the gate open for part of the tidal cycle, but close the gate at some stage during the flood. The earliest reference found to such a device is shown in Figure 7.1.

Figure 7.2 shows an Australian development of this type (Green and Pease 2007). The gate is held open during the first part of the flood tide by the weight of the float and its associated metalwork. As the tide rises it lifts the float, gradually shutting the flap. On the falling tide the weight of the float opens the flap wider than normal, even at very low seaward flows. You can adjust the water level at which the gate closes by re-arranging the alignment of the float.



Figure 7.2: Automatic tidal flap in New South Wales, Australia.

7.1 The Waterman SRT

The Waterman SRT is manufactured by Waterman Industries in the US. Two of these gates have been installed in the UK: one at Goosemoor on the estuary of the Exe; the other at Cone Pill, a small stream draining into the Severn Estuary (Figure 7.3).



Figure 7.3: Waterman SRT

The Cone Pill structure was the first of its type to be installed, in 2004. Matthews and Crundwell (2004) describe the installation, operation and lessons learned.

7.2 The Williams SRT

A different style of SRT device has been developed by Mike Williams from the South West Region of the Environment Agency.

The requirements were exacting. The gate had to be closed at high and low tides, but open at an intermediate stage – so that the water passing landwards was saline rather than backed-up fresh water.

The device is fundamentally a steel plate that rotates across the mouth of a circular-section culvert (Figure 7.4). A weighted float rotates the plate. The operating sequence is shown in Figure 7.5.



The prototype was installed on an outfall on the estuary of the River Axe in January 2009, and has so far operated without significant problems.

A second device is shortly to be installed in Hampshire, where it will replace one of the tidal flaps in the Lymington causeway. This will allow RTE into the reed bed area which had been part of the tidal estuary of the Lymington River until the causeway was built in 1731.

Figure 7.4: Williams SRT during installation on the Axe Estuarv. Devon

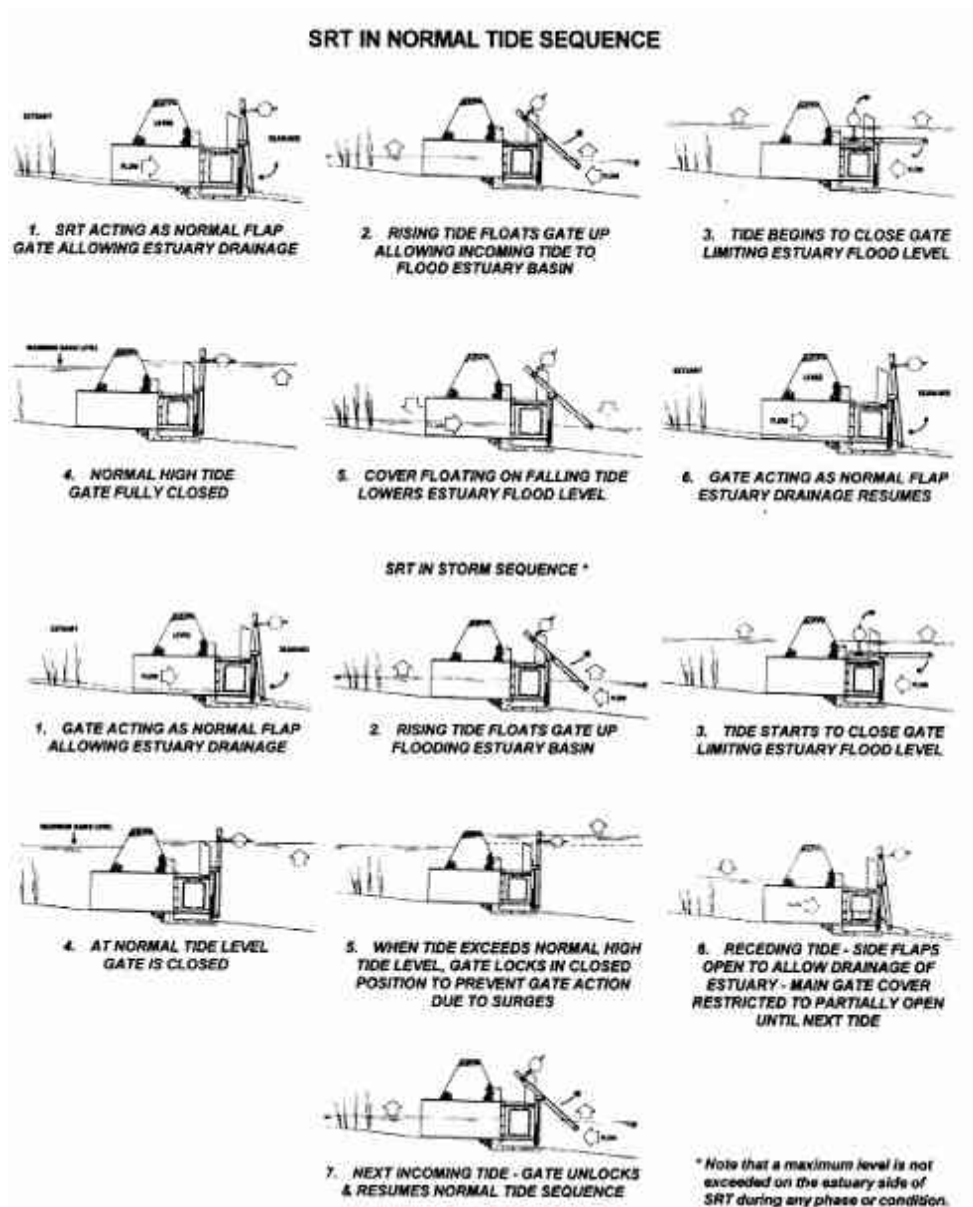


Figure 7.6: Operating sequence of the SRT under both 'normal' and 'flood' conditions. (Courtesy of Waterman Industries Inc)

Suppliers

Stoneman Engineering

Address: Park Works, Station Road, Willand, Cullompton, Devon, EX15 2QA.

Phone: 01884 820369

Watermans, US

Address: Watermans, P.O. Box 458, Exeter, California 93221.

Phone: 559-562-4000

Fax: 559-562-2277

Website: www.watermanusa.com

E-mail: waterman@watermanusa.com

Advantages and disadvantages

Advantages	Disadvantages
Requires no maintenance of electrical power supply	Relatively expensive
Adjustable manually to operate over a specified range	Not tested to Flood Risk Management specifications
Robust, requires no more maintenance than a standard flap gate	Floats can collect debris and need to be cleared
Opens fully, allowing easy fish passage	
Can be fitted as the total flap gate, alongside a normal gate or within an existing flap gate	

What might you need to do to build this?

- Flood modelling
- Permission of landowner
- Flap gate design
- Fabrication firm to build and fit
- Development control consent
- Local authority planning consent (change of land use)

Table of contacts: name, contact details and experience

Name	Contact details	Experience
Mike Williams (Technical Specialist, FRB)	Exminster House, Exeter Internal 7 24 6033 External 01392316033 Mike.williams@environment-agency.gov.uk	Science report: Regulating tidal exchange. Installation of fish-friendly flap gate on River Axe, Seaton
Charles Crundwell Senior Technical Specialist	Riversmeet House, Tewkesbury Internal 7 22 4374 External 01684 864374 Charles.crundwell@environment-agency.gov.uk	SRT Cone Pill Gloucestershire. Improving connectivity between the North Sea and the tidal Trent

7.3 Muted tidal-regulated (MTR) gate, Nehalem Marine.

In this interesting example, the gate is controlled by the water level on the landward side of the structure. This is usually the target of regulation. A float on the landward side operates the gate using a series of levers and a rod that projects through the structure (see Figures 7.7 and 7.8).



Figure 7.7: Float mechanism for an MTR gate at Schneider Creek, Washington State, US. Photograph courtesy of Tom Slocum, Washington Conservation District's North West Region Engineering Program.



Figure 7.8: Gate actuating mechanism for an MTR gate at Schneider Creek, Washington State, US. The door is being held open. Photograph courtesy of Tom Slocum, Washington Conservation District's North West Region Engineering Program.

7.4 Variable backflow flap gate (VBFG™), Juel Tide Gates

This variable backflow flap gate (VBFG™) builds on the principle of the slow-closing flap described in Section 6.2.5. In the original design, the gate was held open by a hydraulic cylinder until the flow of water landwards – and the head acting upon the open gate – exerted enough force to overcome the cylinder. The gate then closed. Current models use a shock-cord rigging arrangement to create the same effect. When the rigging is correctly balanced, the tension increases as the gate closes. This prevents the gate from slamming shut. A major advantage of this design is that the gate is either fully open, or is closed. The rigging can be adjusted to effect closing with almost any level of tidal intrusion.



Figure 7.9: Juel Variable Backflow Flap Gate (VBFG™). The gate is fully open, on the ebb tide. Photos reproduced with permission from Juel Tide Gates of Seattle, Washington, US (www.jueltide.com).

The gate is made from heavy-duty, 316 stainless steel and copolymer. It is designed to require minimal maintenance.

Date 29 February 2012

To Tom Wharf

From Mark Goldberg

CC Charlotte Hitchins, Ifeyinwa Madueke

Subject Options for Dredging Brooklands Lake – Initial Findings

Introduction

Information available to date has suggested that a layer of contaminated silt is present within Brooklands Lake which has the potential to be one of the causes of the “bad” ecological status of the lowest reaches of the Teville Stream. It is therefore proposed that dredging the lake will help to achieve WFD objectives.

Background Information

Chemical testing of 10 silt samples from the lake was undertaken as part of an investigation into the quantity and quality of the silt within the lake by PHB Contractors Ltd in February 2011. Their assessment of the samples indicated that ‘generally the silts contained within the lake would be classed as hazardous if removed to landfill for disposal purposes’. Chemical testing of a sample of silt upstream of Brooklands Lake was also undertaken in February 2011 by the EA. Analysis of results by the analytical laboratory also indicated that the sample would be classed as hazardous waste.

A review of these results by Jacobs has been undertaken utilising the Hazwasteonline application for determination of hazardousness, a copy of which is attached to this memo. This indicates that 9 out of the 10 samples taken by PHB Contractors Ltd would be classed as non hazardous¹ with only sample 3 breaching the hazardous thresholds for total PAH. The single sample taken by the EA was classed as hazardous due to total PAH concentrations. It should be noted that the hazardous property associated with elevated PAH concentrations is ecotoxicity.

Based upon this the majority of the silt within the lake is likely to be considered as non hazardous waste upon dredging.

Further chemical testing of the silt and the water quality of the lake is strongly recommended to confirm this assessment, as this will have significant implications on the costs and overall feasibility of this option. Additional baseline information concerning the current ecological status

¹ It should be noted that, for samples 3, 9, 12, 20, 35, 43 and 56, the assessment of zinc using the worst case compound of zinc chromate triggers a hazardous waste classification due to carcinogenicity. However, a review of the chemical data indicates that insufficient chromium is present within these samples to form zinc chromate at concentrations in excess of the trigger concentration for hazardous properties through carcinogenicity and hence the worst case compound that could feasibly be present within the soils is considered to be zinc sulphate. Zinc sulphate does not have carcinogenic properties and accordingly the concentrations of zinc sulphate present do not trigger a hazardous classification for any of the relevant risk phases.

of the lake i.e. results of invertebrate surveys, is also required in order to assess the need for dredging the lake.

An estimate of the quantity of silt present within the lake was made by PHB Contractors Ltd in February 2011 as part of a survey of the lake. They estimated that 9,960m³ wet volume of silt is contained within the lake. Based upon this a total of 10,000m³ of silt has been used in this assessment.

In the absence of further data and for the purposes of providing a “ball park” cost estimation of this option it has been assumed that 65% of the silt (6,500m³) to be removed will be classed as non hazardous waste with the remainder (3,500m³) considered to be hazardous waste. This has been based upon an area from the inlet to the first island with the reported maximum silt thickness of 0.8m. As stated above, it is recommended that further chemical testing of the silt is carried out to refine the area and hence volume of hazardous silt as uncertainties or variations in hazardous silt quantities will have a significant impact upon scheme costings.

Dredging and Dewatering Options

To reduce costs and facilitate handling of the silt, dewatering of the material on site is recommended. Liquid wastes can no longer be landfilled. Traditional methods of dredging include pumping the silt slurry/sludge to purpose built settlement lagoons. An alternative method is using geotextile dewatering tubes, otherwise known as geotubes. Compared to traditional methods the use of geotubes to dewater high water content silts is reported to be quicker, easier to construct, require less space as tubes can be stacked, lower cost and lower environmental impacts. For these reasons geotubes have been chosen as the preferred method for dewatering.

The porosity of the silt as it currently sits in the bottom of the lake is likely to be between 0.3 and 0.2 (based upon assumed porosity of a silty sand of 0.3 and a silt of 0.2). Although the volume will increase significantly during the dredging operation as the silt is agitated and hence goes into suspension, it is considered that it will return to this original state fairly quickly. If a water removal efficiency of 80% is assumed (up to 90% efficiency reported on contractors website) then between approximately 7,500m³ and 8,500m³ of silt is likely to require disposal. Applying the 65:35 non hazardous to hazardous split described above, this is likely to comprise approximately 2,500-3,000m³ hazardous waste and 5,000-5,500m³ non hazardous waste. The geotubes are typically filled to approximately 80%, which would result in approximately thirty eight to forty two 33mx7m (standard large tube size) geotubes required. Depending upon the available space, this process is likely to take a number of weeks/months before the silt is dry enough to handle as a solid.

Water removed from the silt may be returned to the lake following treatment of the effluent. Depending upon the nature and mobility of the contaminants and the effluent this may require a baffled oil water separator and possibly secondary methods of treatment such as a sand filter or activated carbon. However, this is heavily reliant upon chemical analysis of the water, its silt content and the leachability of the contaminants. It is also likely to require a discharge consent to be obtained from the Environment Agency. Another option may be to discharge the water to sewer where it is likely that there will be less stringent standards imposed and hence a reduced effluent treatment train could be used. Chemical testing of the water within the silt is recommended to refine this aspect and help identify the need for any treatment of the water.

Dewatering of the silt will not reduce the contamination; however, the geotubes may be used to contain the contaminated silt whilst treatment, such as bioremediation, could be applied depending upon the nature of the contamination. It is likely that an environmental permit for a mobile treatment plant will be required for this process.

Re-use / Disposal Options

Depending upon the success of any treatment during the dewatering process some of the material may still be classed as hazardous waste. If this is the case then the most feasible option is likely to be disposal to landfill as hazardous waste cannot be reused on site without further treatment to reduce its hazardousness. All waste must be treated before it can be sent to landfill. Dewatering of the silt to facilitate its handling, reduce the volume of waste to be sent for landfill and potentially reduce the hazardousness of the silt will meet this requirement.

The potential for any non hazardous waste to be reused on site needs to be assessed using a risk based approach which looks at both the risk to human health and risk to the ecology of the area. An initial screening exercise has been undertaken by Jacobs to this effect, a copy of which is attached to this memo.

The significance of the analytical results in the context of risk to human health, have been assessed by comparison with generic assessment criteria (GACs) developed using the Environment Agency / DEFRA Contaminated Land Exposure Assessment (CLEA) model. These include Soil Guideline Values (SGVs) published by the EA / DEFRA and Generic Assessment Criteria calculated using the CLEA methodology and published by authoritative sources (LQM / CIEH 2nd Edition July 2009 and EIC/ AGS/ CL:AIRE GACs December 2009). It should be noted that, while the LQM/ CIEH and EIC / AGS / CL:AIRE GACs have been developed in accordance with the CLEA guidance, it is possible that policy decisions may be taken in development of the formal EA / DEFRA SGVs resulting in significant differences between the GACs and future SGVs. It is also important to note that the SGVs and GACs are used here as generic screening criteria. Exceedance of the SGV or GAC does not mean that there is a significant possibility of significant harm to end-users, but that further assessment is required.

A land use of residential without garden has been considered the most appropriate based upon the use of the area as public open space. This indicates that of the nine samples deemed to be non hazardous, three would not be suitable for reuse due to exceedances of benzo(a)pyrene (samples 12 and 23) and lead (sample 46).

The potential risk to biodiversity has been initially been assessed through comparison of results with Environment Agency Ecological Risk Assessment Soil Screening Values (ERA SSVs). ERA SSVs are concentrations of chemical substances found in soils below which there are not expected to be any adverse effects on wildlife such as birds, mammals, plants and soil invertebrates, or on the microbial functioning of soils. While they were developed specifically for assessing impact on specified receptors such as SSSIs, nature reserves and special areas of conservation, they are used in this assessment to provide the most conservative screening scenario.

If ERA SSVs are not available for particular determinands then the more conservative US Environmental Protection Agency (EPA) Ecological Soil Screening Levels (Eco-SSLs) have been consulted. Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or

on soil. They are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds and mammals. Where more than one of the four groups has been derived for a given determinand, the lowest level is used in this assessment to ensure protection to all ecological receptors.

This indicates that none of the samples would be suitable for reuse due to exceedances of one or more metals and / or concentrations of benzo(a)pyrene.

Based upon this assessment none of the silt dredged from the lake is likely to be suitable for direct reuse on site and hence, as stated above it is estimated that approximately 7,500m³ and 8,500m³ of dried silt is likely to require further treatment or disposal.

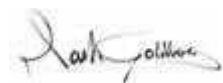
Conclusions and Recommendations

The chemical testing to date suggests that silt present within Brooklands Lake is contaminated to varying degrees but that it all has the potential to impact upon the ecology/biodiversity of the area.

Based on the results so far, the waste classification of the silt would approximate to a hazardous to non-hazardous waste ratio of 35:65. Volumes of the silt can be reduced and handling facilitated by dewatering to between 7,500m³ and 8,500m³.

It is strongly recommended that additional silt sampling along with chemical and geotechnical testing is undertaken to confirm this assessment and refine the categorisation of the silt in terms of contamination and hence re-use/disposal options.

Kind regards,



Mark Goldberg