

## 5 OUTLET DESIGN



*What about the outlet? What effect will its position and design have on the efficiency of the pond?*

### 5.1 Introduction

Significant research on the design and positioning of the outlet has been lacking, and there is little ‘previous work’ to report other than recommended depths.

More recently, research undertaken for these guidelines by Shilton (2001) has presented some insight into this area and this is reported below.

### 5.2 Previous Work

#### 5.2.1 Outlet Depth

The design manual of Mara & Pearson (1998) recommends the following depths for outlets:

Anaerobic Ponds	300mm
Facultative Ponds	600mm

In anaerobic ponds the outlet should be deep enough to avoid any surface crust. In facultative ponds the depth is selected so as to discharge from below the maximum depth of the algal band. If an outlet weir is to be used, as opposed to a simple outlet pipe, then this should incorporate a scum guard that extends to the indicated depth (Mara & Pearson 1998).

In maturation ponds, where “algal bands are irrelevant” (Mara & Pearson, 1998, pg 62), the outlet should be located close to the surface.

### 5.3 New Thinking

#### 5.3.1 Outlet Position – Influence on Efficiency

There is no doubt that the positioning of the outlet is critical in terms of hydraulic efficiency. As we now realise the wastewater tends to circulate around the pond rather than simply moving slowly from the inlet towards the outlet.

If wastewater swirls from the inlet around past the outlet, then short-circuiting will occur and treatment efficiency will be compromised. It is therefore important to ensure that the outlet is kept out of the main flowpath of the incoming wastewater.

***Outlets should be placed out of the main flowpath of the incoming wastewater.***

The engineer needs to consider what the likely flow pattern would be and then select an outlet position in a ‘sheltered’ spot. Some practical suggestions for doing this are given towards the end of this section, but firstly we need to consider what effect moving the outlet position might have on the overall flow pattern.

### 5.3.2 Outlet Position – Influence on Flow Pattern

Does the positioning of the outlet affect the main circulation pattern?

After discussions with engineers on this matter, the consensus was that if the position of the outlet is moved then it might alter the circulation pattern in the pond by ‘dragging’ the flow towards it. However, in practice this does not appear to be the case. Observations made during laboratory and modelling work indicated that the outlet had only a localised influence and moving it certainly did not alter the bulk flow pattern that existed in the pond. This is a useful observation as it means that the inlet and baffling can be sorted out first.

Clearly the outlet position must be carefully considered, but as a ‘secondary function’. This is to say, that after the flow pattern has been optimised by design of the inlet and the shape/baffles, then the outlet can be placed for maximum efficiency without the likelihood that it will subsequently alter the flow pattern.

***Final outlet positioning can be selected after the inlet position/type and pond shape/baffling have been designed.***

### 5.3.3 Outlet Manifolds

Some engineers have raised the possibility of using outlet manifolds. These might consist of a weir running down the width of the pond at the opposite end from the inlet. However, as our understanding of flow behaviour has improved, we now realise that wastewater in a pond doesn’t simply move slowly from one end to the other.

It therefore seems likely that despite the expense of installing such a structure, it would actually compromise pond performance because it exposes the outlet over a wide width therefore making it more difficult to shelter and protect.

***Outlet manifolds are not recommended.***

### 5.3.4 Outlet Position - Design Suggestions

It has generally been considered that the best position for an outlet is at the opposite end of the pond to the inlet. However, we now realise that wastewater can swirl rapidly around from the inlet past the outlet.

Picking the best spot for the outlet in any pond is still going to require some reasonable degree of judgment from the design engineer but the following ideas should help:

#### Hydraulic Dead Spots

‘Tuck’ the outlet close into a corner or, if you have an irregular shaped pond, into a zone that obviously is out of the main flow path.

#### Use of Baffles as ‘Shields’

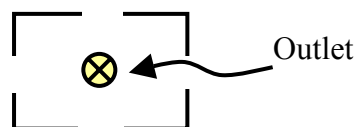
The application of baffles is, of course, far broader than for simply protecting the outlet. However, they can also be used to do exactly this with good results. In the following section on baffles, we will see the benefit of locating an outlet at the opposite end of the pond to the inlet and then placing a baffle to shield it from flow that swirls around towards it.

#### Central Outlets

This idea involves positioning the outlet in the middle of the pond and using the inlet to actually encourage a swirling action around the outer edge so that the flow slowly spirals into the centre. This idea was modelled for a pond on the computer and it worked extremely well. However, the probability that the wind could drive the flow over into the central zone needs to be carefully considered. Although this sort of a design offers great potential, at the moment it is untested in the field and a full-scale research study of its performance is perhaps needed before it can be generally recommended.

#### Use of Flow Deflectors

Further protection of a central outlet can be achieved by placing small walls or sheets of material around it to deflect flow away from this area (a simple diagram is shown below). The idea is to ‘sort of’ build a pond within a pond.



#### Wind

In a later section we discuss the relative significance of the inlet versus wind. However, for now it should be realised that on a windy day the wind will certainly have some effect and therefore a sensible separation distance is required between the inlet and outlet. This same point applies when using a central outlet. For example, on a rectangular pond if the outlet is to be placed in the centre zone it might be better kept towards the opposite end of this zone away from the inlet.

*Tip: If using a baffle as a shield, be sure that it doesn't leak some of the flow through – baffle leakage is not uncommon!*