

## Description

A multiple treatment system uses two or more BMPs in series. Some examples of multiple systems include: settling basin combined with a sand filter; settling basin or biofilter combined with an infiltration basin or trench; extended detention zone on a wet pond.

## California Experience

The research wetlands at Fremont, California are a combination of wet ponds, wetlands, and vegetated controls.

## Advantages

- BMPs that are less sensitive to high pollutant loadings, especially solids, can be used to pretreat runoff for sand filters and infiltration devices where the potential for clogging exists.
- BMPs which target different constituents can be combined to provide treatment for all constituents of concern.
- BMPs which use different removal processes (sedimentation, filtration, biological uptake) can be combined to improve the overall removal efficiency for a given constituent.
- BMPs in series can provide redundancy and reduce the likelihood of total system failure.

## Limitations

- Capital costs of multiple systems are higher than for single devices.
- Space requirements are greater than that required for a single technology.

## Design and Sizing Guidelines

Refer to individual treatment control BMP fact sheets.

## Performance

- Be aware that placing multiple BMPs in series does not necessarily result in combined cumulative increased performance. This is because the first BMP may already achieve part of the gain normally achieved by the second BMP. On the other hand, picking the right combination can often help optimize performance of the second BMP since the influent to the second BMP is of more consistent water quality, and thus more consistent performance, thereby allowing the BMP to achieve its highest performance.

## Design Considerations

- Area Required
- Slope
- Water Availability
- Hydraulic Head
- Environmental Side-effects

## Targeted Constituents

<input checked="" type="checkbox"/>	Sediment	■
<input checked="" type="checkbox"/>	Nutrients	●
<input checked="" type="checkbox"/>	Trash	■
<input checked="" type="checkbox"/>	Metals	■
<input checked="" type="checkbox"/>	Bacteria	▲
<input checked="" type="checkbox"/>	Oil and Grease	■
<input checked="" type="checkbox"/>	Organics	■

### Legend (Removal Effectiveness)

- Low
- High
- ▲ Medium



- When addressing multiple constituents through multiple BMPs, one BMP may optimize removal of a particular constituent, while another BMP optimizes removal of a different constituent or set of constituents. Therefore, selecting the right combination of BMPs can be very constructive in collectively removing multiple constituents.

## **Siting Criteria**

Refer to individual treatment control BMP fact sheets.

## **Additional Design Guidelines**

- When using two or more BMPs in series, it may be possible to reduce the size of BMPs.
- Existing pretreatment requirements may be able to be avoided when using some BMP combinations.

## **Maintenance**

Refer to individual treatment control BMP fact sheets.

## **Cost**

Refer to individual treatment control BMP fact sheets.

## **Resources and Sources of Additional Information**

Refer to individual treatment control BMP fact sheets.