Individual NWRM
Overland flow areas
This report was prepared by the NWRM project, led by Office International de l’Eau (OIEau), in consortium with Actéon Environment (France), AMEC Foster Wheeler (United Kingdom), BEF (Baltic States), ENVECO (Sweden), IACO (Cyprus/Greece), IMDEA Water (Spain), REC (Hungary/Central & Eastern Europe), REKK inc. (Hungary), SLU (Sweden) and SRUC (UK) under contract 07.0330/2013/659147/SER/ENV.C1 for the Directorate-General for Environment of the European Commission. The information and views set out in this report represent NWRM project’s views on the subject matter and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this report. Neither the Commission nor any person acting on the Commission’s behalf may be held responsible for the use which may be made of the information contained therein.

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I. **NWRM Description**

Typically, overland flow areas are set asides used to minimize the negative impacts of forest management on water quality. They are most commonly associated with peatland forestry in Finland but could be applicable in other areas of Europe. Overland flow areas collect some of the excess sediment produced during ditch maintenance and other forest management operations such as road building or harvesting. Overland flow areas are created by building a semi-permeable dam in a forest ditch. Upstream of the dam, lateral ditches are constructed to transport water into the surrounding catchment. During periods of high flow, water will overflow the lateral ditches and travel across land to reach the receiving lake or stream. As the water travels across land, its velocity will be slowed and much of the sediment being carried will be deposited. At periods of low flows, the permeable dam will slow water flow and cause deposition of sediment. Existing wetlands may function as overland flow areas but the use of ecologically valuable and endangered mires should be avoided due to possible changes in vegetation composition. Overland flow areas can also be part of more complex system for water treatment from agricultural areas and landfills.

II. **Illustration**

![Schematic of a constructed overland flow area (from Liljaniemi et al. 2003)](image)

III. **Geographic Applicability**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Applicability</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial Surfaces</td>
<td>Possible</td>
<td>Overland flow areas may be used as part of water treatment systems from, e.g., re-cultivated landfills.</td>
</tr>
<tr>
<td>Agricultural Areas</td>
<td>Possible</td>
<td>While this measure is primarily associated with forest management it may also be used in agricultural areas. Theoretically it should be possible to apply this</td>
</tr>
</tbody>
</table>
F14: Overland flow areas

<table>
<thead>
<tr>
<th>Region</th>
<th>Applicability</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Europe</td>
<td>Possible</td>
<td>Overland flow areas are likely to be applicable in the cooler, wetter regions of Western Europe where precipitation exceeds potential evapotranspiration and large increases in runoff following clearcutting are possible.</td>
</tr>
<tr>
<td>Mediterranean</td>
<td>No</td>
<td>Overland flow areas are not likely to be relevant in areas where potential evapotranspiration exceeds precipitation and large increases in runoff following clearcutting of forests are not likely to occur.</td>
</tr>
<tr>
<td>Baltic Sea</td>
<td>Yes</td>
<td>Overland flow areas are likely to be applicable in the cooler, wetter regions of the Baltic Sea drainage basin where precipitation exceeds potential evapotranspiration and large increases in runoff following clearcutting are possible.</td>
</tr>
<tr>
<td>Eastern Europe and Danube</td>
<td>Possible</td>
<td>Overland flow areas may be applicable in the cooler, wetter regions of Eastern Europe and the Danube basin where precipitation exceeds potential evapotranspiration and large increases in runoff following clearcutting are possible.</td>
</tr>
</tbody>
</table>

IV. Scale

<table>
<thead>
<tr>
<th>Upstream Drainage Area/Catchment Area</th>
<th>0-0.1km²</th>
<th>0.1-1.0km²</th>
<th>1-10km²</th>
<th>10-100km²</th>
<th>100-1000km²</th>
<th>&gt;1000km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence</td>
<td>Yes</td>
<td>Yes</td>
<td>Possible</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Overland flow areas are a measure designed primarily to deal with local forestry effects. As such, they need a limited upstream drainage area but can have beneficial effects in much larger downstream areas. The spatial scale of overland flow areas mean they are only suitable for application in relatively small areas such as that drained by a single ditch or small ditch network. Also
as a part of a larger water treatment system, their spatial impact will be limited.

V. Biophysical Impacts

<table>
<thead>
<tr>
<th>Biophysical Impacts</th>
<th>Rating</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slowing &amp; Storing Runoff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Store Runoff</td>
<td>High</td>
<td>One of the primary purposes of overland flow areas is to store runoff. Storing runoff on the land allows sediments to be deposited and this can help to prevent sediment pollution of downstream receiving waters.</td>
</tr>
<tr>
<td>Slow Runoff</td>
<td>High</td>
<td>Because overland flow areas store runoff, they will also slow runoff. Slowing runoff facilitates deposition of suspended sediments and can have a beneficial effect on water quality in downstream water bodies.</td>
</tr>
<tr>
<td>Store River Water</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Slow River Water</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Reducing Runoff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase Evapotranspiration</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Increase Infiltration and/or groundwater recharge</td>
<td>Medium</td>
<td>Because overland flow areas route water over land, they can contribute to increased infiltration or groundwater recharge. However, the increase is likely to be Medium as overland flows typically occur during wet periods (such as early spring) when soils are already at their wettest.</td>
</tr>
<tr>
<td>Increase soil water retention</td>
<td>Medium</td>
<td>There is a potential for overland flow areas to increase soil water retention as they retain water on the landscape instead of routing it directly to ditches or streams. This effect is likely to be moderate as overland flows are most common when soils are at their wettest.</td>
</tr>
<tr>
<td>Reducing Pollution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce pollutant sources</td>
<td>High</td>
<td>The main purpose of overland flow areas is to reduce sediment pollution primarily associated with forestry operations including ditch maintenance, road building and forest harvesting.</td>
</tr>
<tr>
<td>Intercept pollution pathways</td>
<td>High</td>
<td>The mechanism by which overland flow areas reduce pollutant sources is through interception of particulate material suspended in the water column. By passing water over land areas, much of the sediment load can be deposited. Reducing sediment concentrations in waters draining managed forests can have beneficial effects on downstream water bodies.</td>
</tr>
</tbody>
</table>
Overland flow areas limit sediment delivery by passing water from streams or ditches over terrestrial areas. This has the effect of slowing water flows. Slower water flows over rougher environments (terrestrial vs. ditch) will facilitate the deposition of suspended material.

Overland flow areas can help to prevent deterioration of aquatic habitat associated with sediment pollution. As they are located near water bodies, overland flow areas will create valuable riparian habitats that will help to increase biodiversity.

Depending on their size, overland flow areas may in some circumstances create or improve terrestrial habitat.

Overland flow areas can have a moderate effect on water storage. Typically, the effect is quite local and short lived but it may be sufficient to mitigate some flood peaks during spring runoff.

Preventing sediment inputs to receiving lakes and streams may help to preserve spawning habitat. This would help to maintain fish stocks through sustainable recruitment.

Preventing sediment inputs to receiving lakes and streams may help to preserve spawning habitat and the streambeds used by such species as freshwater pearl mussel. Excessive sediment inputs can smother the streambeds needed for spawning, or pearl mussel habitat. This can lead to local extirpation of both fish and invertebrates.
<table>
<thead>
<tr>
<th>Environmental Service</th>
<th>Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change adaptation and mitigation</td>
<td>Low</td>
<td>Increased emissions of N(_2)O and CH(_4) are possible from overland flow areas, but they are most likely a minor source.</td>
</tr>
<tr>
<td>Groundwater / aquifer recharge</td>
<td>Medium</td>
<td>By routing water over the land, there is a potential for groundwater aquifer recharge. However, the effect of overland flow areas on enhancing aquifer recharge is likely to be limited as this measure typically only works during high flow periods when soils are at their wettest.</td>
</tr>
<tr>
<td>Flood risk reduction</td>
<td>Low</td>
<td>Overland flow areas may play a role in flood risk reduction as they will slow the transit of water through the forest landscape during high flow conditions. This may have beneficial effects on downstream flood peaks.</td>
</tr>
<tr>
<td>Erosion / sediment control</td>
<td>High</td>
<td>Sediment control is the main purpose of overland flow areas.</td>
</tr>
<tr>
<td>Filtration of pollutants</td>
<td>High</td>
<td>Overland flow areas control and limit downstream water pollution by intercepting suspended sediment and trapping it on the land. The suspended sediments in stream or ditch water settle out when the water passes over overland flow areas, thus the water leaving an overland flow area will be cleaner than that entering as sediment-related pollutants including phosphorus and heavy metals will have been filtered out and deposited onto land.</td>
</tr>
<tr>
<td>Cultural</td>
<td></td>
<td>Overland flow areas may potentially create habitats suitable for some bird species and provide opportunities for bird watching.</td>
</tr>
<tr>
<td>Aesthetic / cultural value</td>
<td>Low</td>
<td>Through improving water quality, overland flow areas may have indirect effect on aesthetic properties of downstream water bodies.</td>
</tr>
<tr>
<td>Abiotic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navigation</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Geological resources</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Energy production</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
## VII. Policy Objectives

<table>
<thead>
<tr>
<th>Policy Objective</th>
<th>Rating</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Framework Directive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achieve Good Surface Water Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improving status of biological quality elements</td>
<td>Low</td>
<td>As with many forestry measures, there is a scale mismatch between the zone of influence of overland flow areas and the size of Water Framework Directive (WFD) water bodies. Overland flow areas can lead to local improvements in biological quality elements, especially for benthic dwelling species. They can also lead to improvements in physico-chemical status as a result of lowered nutrient inputs and potentially also improve priority substance status if there is excessive mercury associated with sediments exported from forests.</td>
</tr>
<tr>
<td>Improving status of physico-chemical quality elements</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Improving status of hydromorphological quality elements</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Improving chemical status and priority substances</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Achieve Good GW Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved quantitative status</td>
<td>Low</td>
<td>The effect of overland flow areas on groundwater recharge is limited, as this measure usually works during flood periods when soil is saturated with water.</td>
</tr>
<tr>
<td>Improved chemical status</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Prevent surface water status deterioration</td>
<td>Medium</td>
<td>Overland flow areas are used to limit the potential negative consequences of forestry on downstream receiving water. As such, this measure can help to prevent deterioration of surface water body WFD status.</td>
</tr>
<tr>
<td>Prevent groundwater status deterioration</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td><strong>Floods Directive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take adequate and co-ordinated measures to reduce flood risks</td>
<td>Low</td>
<td>Overland flow areas will slow the velocity of water leaving the forest landscape during peak flow periods when soils are at their wettest. As such, they can make a limited contribution to reducing flood risks.</td>
</tr>
<tr>
<td><strong>Habitats and Birds Directives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection of Important Habitats</td>
<td>Medium</td>
<td>Overland flow areas can be important for preserving the habitat of aquatic species which depend on well-oxygenated stream beds. Overland flow areas can help to limit sediment inputs from managed forests which can later smother stream beds, destroying spawning habitat or extirpating benthic invertebrates such as freshwater pearl mussel. If wetlands are used as overland flow areas, they may also serve to preserve bird habitat.</td>
</tr>
</tbody>
</table>
F14: Overland flow areas

2020 Biodiversity Strategy

| Better protection for ecosystems and more use of Green Infrastructure | Medium | Overland flow areas offer increased protection for downstream aquatic ecosystems by limiting the potential for excessive sediment inputs from managed forests. |
| More sustainable agriculture and forestry | Medium | Overland flow areas will help to make forestry more sustainable as they can limit some negative impacts associated with sediment pollution. |
| Better management of fish stocks | Medium | By limiting the sediment pollution that will potentially smother streambed spawning habitat, overland flow areas can contribute to better management of freshwater fish stocks. |
| Prevention of biodiversity loss | Medium | By limiting the sediment pollution that will potentially smother streambed habitat, overland flow areas can contribute to prevention of aquatic biodiversity loss, especially for slow moving long-lived species such as freshwater pearl mussel. Overland flow areas may also help to preserve riparian biodiversity. |

VIII. Design Guidance

Design Parameters | Evidence
---|---
Dimensions | The dimensions of overland flow areas will be dependent on the size of the upstream catchment. Larger areas will be needed with larger upstream catchments.
Space required | Ideally, the space needed for overland flow areas will not have impact on productive forest areas. If overland flow areas can be situated on mires or wetlands, their impact on forestry will be minimized while maintaining their sediment retention function.
Location | Overland flow areas will typically be located within the ditch network of managed boreal forests.
Site and slope stability | This measure is typically located on the flat forest landscapes of Fennoscandia.
Soils and groundwater | |
Pre-treatment requirements | |
Synergies with Other Measures | This measure can be part of a bundle of measures designed to minimize forestry impacts on water quality. Relevant measures include forest riparian buffers (F1), water sensitive driving (F7), sediment capture ponds (F9), appropriate design of roads and stream crossings (F8) and peak flow control structures (F13).
IX. Cost

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Cost Range</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Acquisition</td>
<td></td>
<td>Typically there are no costs of land acquisition.</td>
</tr>
<tr>
<td>Investigations &amp; Studies</td>
<td></td>
<td>The effectiveness of this measure will depend on how much flow velocities are slowed. Thus, investigations or studies should be conducted to determine the likely amount and timing of runoff to be processed by an overland flow area</td>
</tr>
<tr>
<td>Capital Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Costs</td>
<td></td>
<td>There may be opportunity costs associated with this measure if the overland flow area is sited on productive forest land. Using an area for overland flows instead of forest production may negatively impact tree growth and the income which could potentially be obtained from forest harvesting.</td>
</tr>
</tbody>
</table>

X. Governance and Implementation

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

XI. Incentives supporting the financing of the NWRM

<table>
<thead>
<tr>
<th>Type</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

XII. References

<table>
<thead>
<tr>
<th>Reference</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citation</td>
<td>Summary</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---------</td>
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</tbody>
</table>