

Planted Farm-scale Buffer Zones

Working with Nature for Waterway Protection

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FH Wetland Systems

Farm Scale Buffer Zones

This document shows summary examples of farm scale buffer zones for water filtration and waterway protection using plants and the natural capacity of nature to cleanse and filter water.

Note that some of the measures described in this document may require liaison with and/or permissions from official bodies in certain circumstances. For example works within an SAC requires liaison with National Parks and Wildlife Service and work within a stream channel will require liaison with Inland Fisheries Ireland.

The measures here assume that standard agricultural good practice is being adhered to for all standard storage and spreading requirements. Thus planted filters for yard runoff are for clean yard and roof areas only, excluding slurry, silage effluent and washings from parlours or used yard areas. For wash water inputs an ICW system may be used; which will require an area of 200% of the total yard area including roof surfaces; as well as planning permission and a discharge licence. Follow standard Dept of Ag guidance on ICW systems for design and construction.

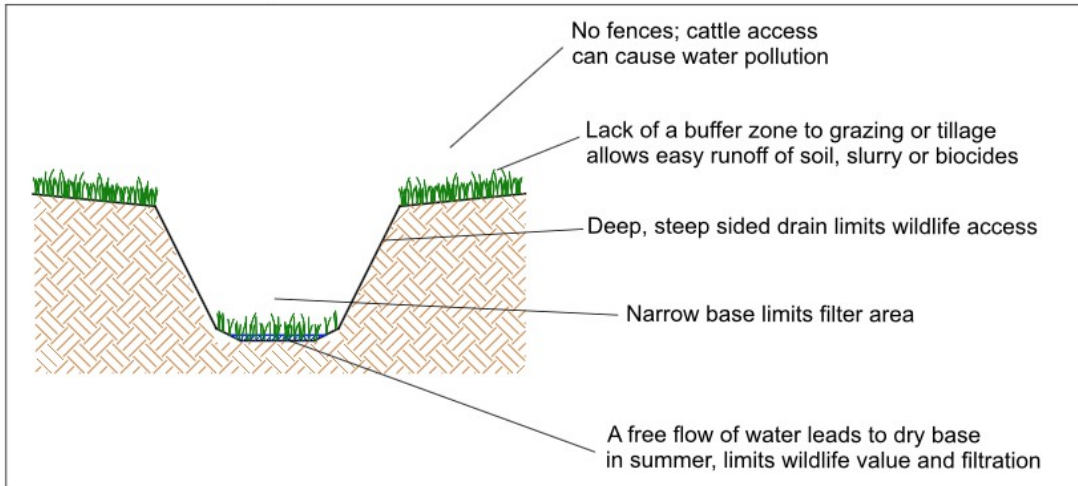
One of the challenges of using liquid slurry as a way to cycle farm nutrients is that the risks to waterways is ever-present. While contour hedgerows, riparian buffers and in-field buffer zones can help to limit the negative impacts of slurry runoff on waterways, a healthier nutrient cycling option is farm-scale composting. With the appropriate investment at government level this could be as straightforward for the farmer as liquid nutrient storage; and much more effective at building healthy soils, cycling and holding nutrients, improving drainage and also improving the moisture holding capacity of soils – helpful in a climate context of wetter west of Ireland weather and drier east of Ireland weather.

This document gives a brief overview of options suitable for a variety of soil types. In general terms wetland planted filter basins and ponds are more suited to impermeable soils, whereas tree planted systems such as infiltration basins and wooded riparian buffer zones are more suitable for free draining soils. Essentially, lower growing wetland plants (to 2-3m in height) provide a biomass layer within the marsh or drain to provide physical, chemical and microbiological filtration; whereas for freer draining soils what is needed is the deeper rooting trees to catch and mop up nutrients within the subsoil, as it migrates down into groundwaters or laterally towards rivers and streams.

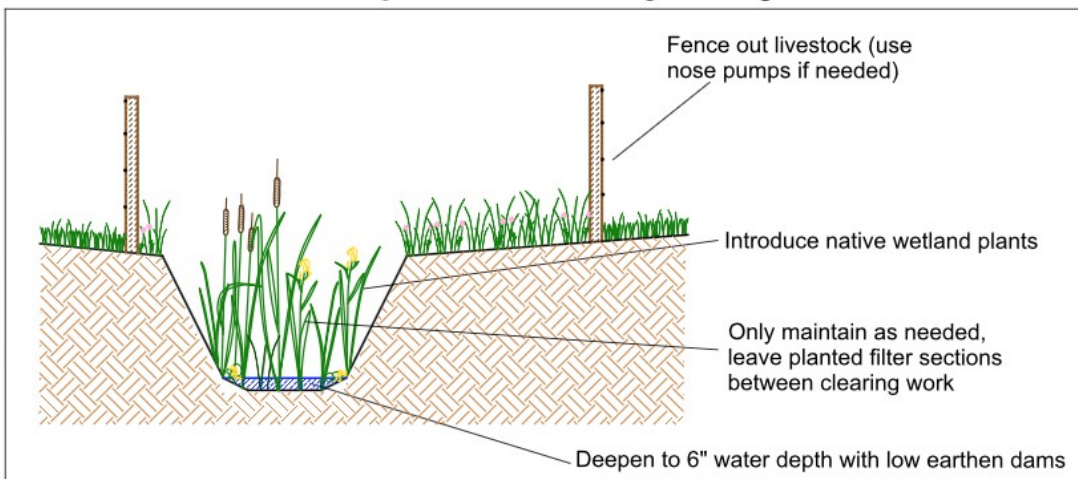
Drain Management for Wildlife and Water Quality

The management of small watercourses and farm drains has a large impact on the water quality in the wider catchment and on wildlife. Careful management can filter water, protect against downstream flooding and droughts and provides shelter and food for wetland birds, dragonflies, frogs and other wildlife.

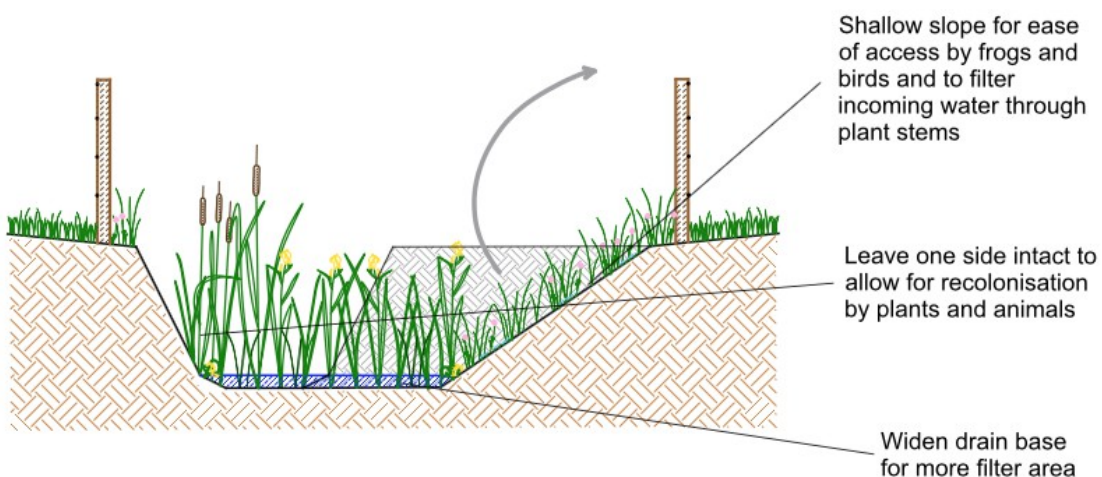
1 - Common drain profile:



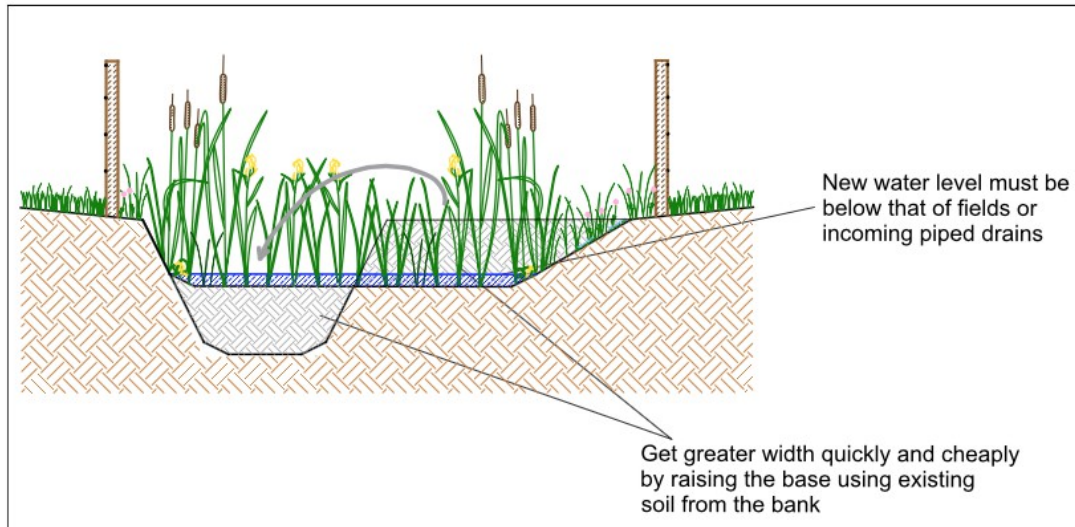
2 - Basic Measures: Fencing. Low dams. Planting. Leaving filter sections.



3 - Additional Measures: Widen drain. Soften edge slope.



4 - Widening Option: Gain further width by raising the drain base



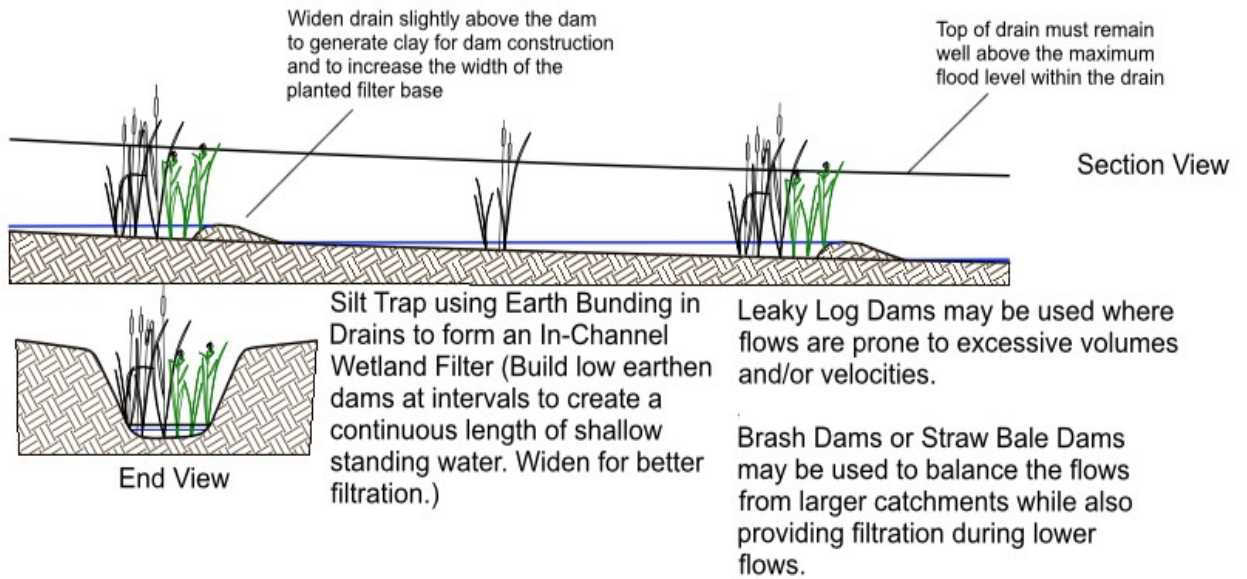
Drain Maintenance for Wildlife and Water Quality:

- Minimal intervention to minimise habitat disturbance and generation of silt.
- Clear from one side only to permit rapid recolonisation of plants and insects.
- Leave 20-50m at the lower end of drain as a planted filter.
- For long drains, leave 10-20m of planted sections intact for recolonisation and filtration.
- Reinstate or work around earthen dams to ensure that the drain holds water for ongoing habitat and filtration.
- Note that works in streams and rivers requires more baseline assessments and permissions from IFI and/or NPWS than outlined here.

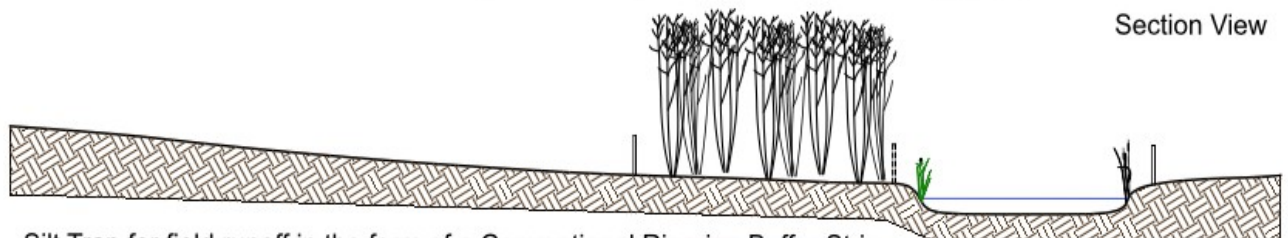
Riparian and Field Margin Buffer Zones for Habitat and Filtration:

- Wooded buffer zones of native trees provide uptake of nutrients, wildlife habitat and a firewood or timber crop.
- Ideally wooded or grassed buffer zones should be gently sloped and fenced off from livestock with a width of 5-10m or more.
- Buffer zones at the lower edge of field margins also help to filter water, even if they are a long way from the drain or stream.
- Wetland buffer zones filter soil, slurry and biocides and provide habitat for insects and birdlife.
- For wetland buffer zones use minimal digger work to achieve maximum water-holding on the site, to allow water to settle in hollows or wet corners or fields.

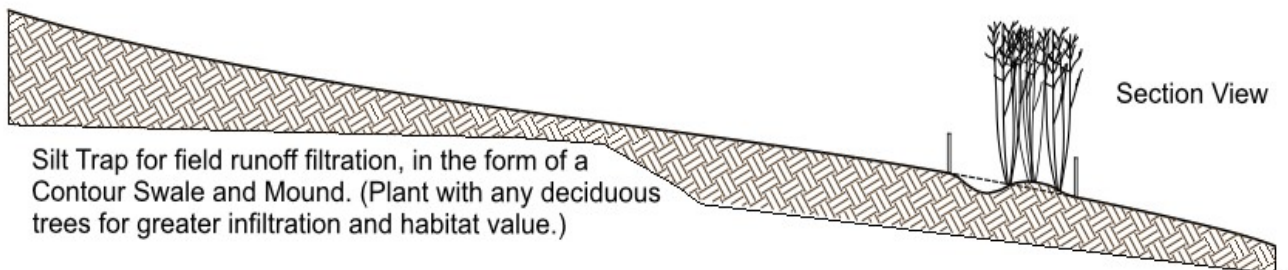
In-Channel Filter Buffers for silt settlement in farm drains (Planted Drains)



Silt Traps for field runoff - for either free draining and impermeable soil types



Silt Trap for field runoff in the form of a Conventional Riparian Buffer Strip. (Essentially a wider fenced area bordering the river. May be left to develop naturally as long grasses and wildflowers or planted with wetland plants to filter the surface runoff; or plant with willows or other native deciduous trees for subsurface flow filtration. The wider the strip the greater the uptake of silt, N and P.)

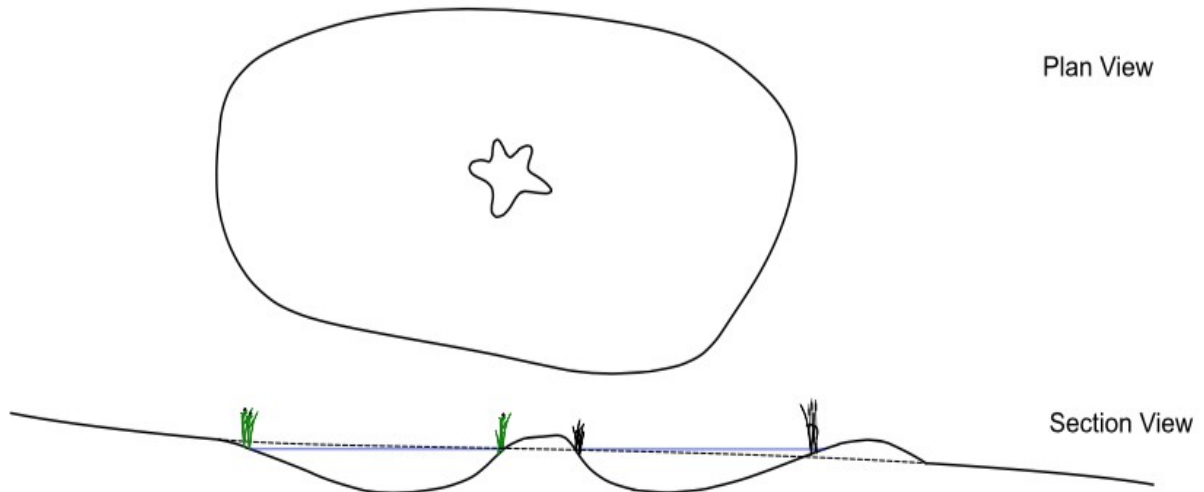


Silt Trap for field runoff filtration, in the form of a Contour Swale and Mound. (Plant with any deciduous trees for greater infiltration and habitat value.)

Other methods for reducing field runoff

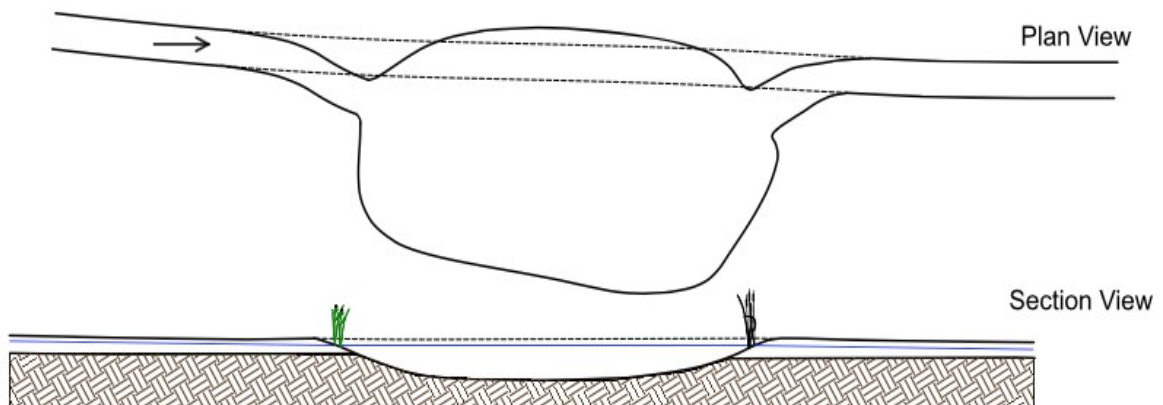
Note that these are just two methods for reducing runoff of silt and nutrients from fields. Other methods include, for example, contour hedgerows, establishment of woodlands in sloping ground, silvopasture, agroforestry, holistic planned grazing, maintaining a continuous cover of plants on the soil, permanent pasture, soil building through applications of humus rich compost, limiting artificial nutrient and chemical additions to maintain and support soil health, encouragement of mycorrhizal fungi within the soil and a suite of other methods for optimising soil health, and thus both free drainage and moisture retention.

Farm Ponds - for impermeable soils or high water table



Farm Pond with island for habitat on farms with heavy clay soils or high groundwater. (Rain-fed or clean roof runoff only. Note shaped edges of island as shelter for birds. Keep edge slopes shallow for greater habitat value and safety.)

Even small farm ponds can offer a lot of habitat benefits and can help balance the flow patterns in the wider catchment; slowing the flow of rainwater into nearby streams.



In-Channel Farm Ponds can be used in farm drains for habitat enhancement or for additional silt trap function and/or nutrient capture.

(Suitable for farms with poor draining soils. The larger the pond the greater the uptake of any silt, N and P from the water in the drain. Plant with wetland plants for greater filtration. Make edges not steeper than 1:3 for habitat value and safety.)

For using farm ponds as a source of irrigation water; remember the 3 Cs of rainwater harvesting:

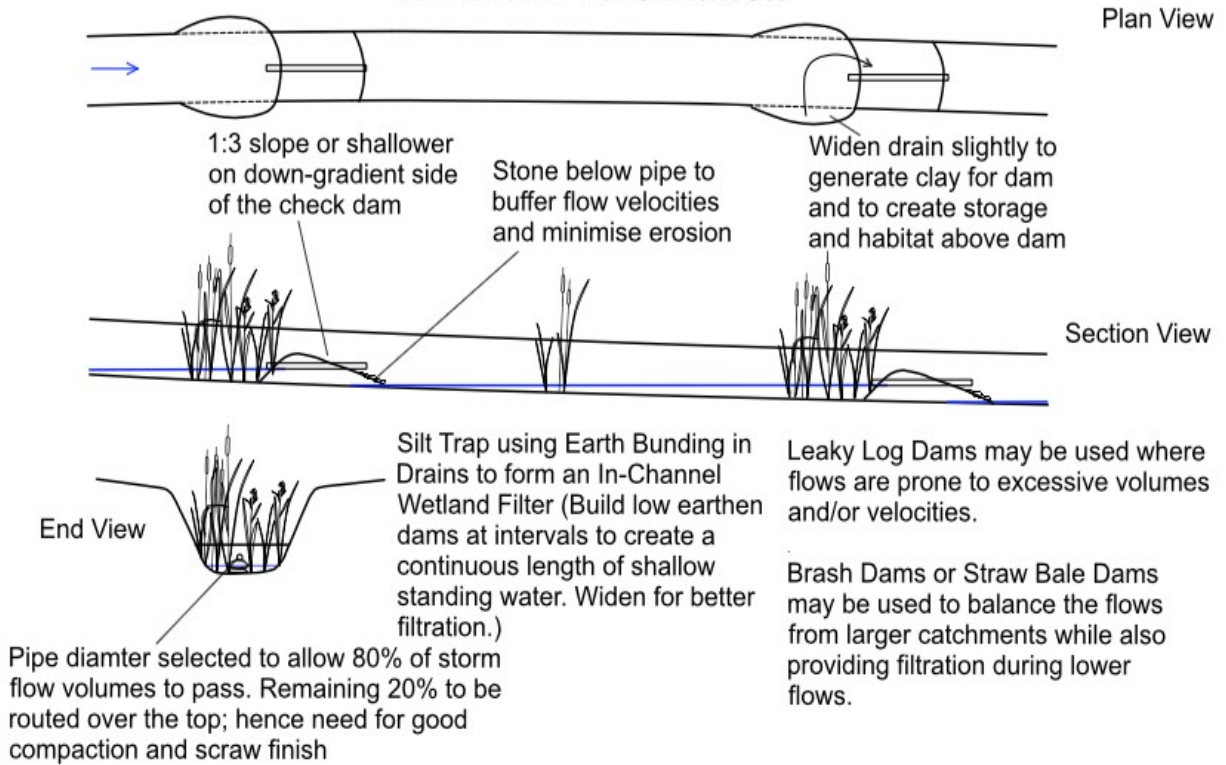
- 1 - Catchment (source of water, be that a clean roof or fields),
- 2 - Conveyance (good gutters or planted drains that deliver the water),
- 3 - Container (storage, in this case the pond itself).

The cleaner and more robust these are, the more useful and reliable will be your water supply from rain harvested water.

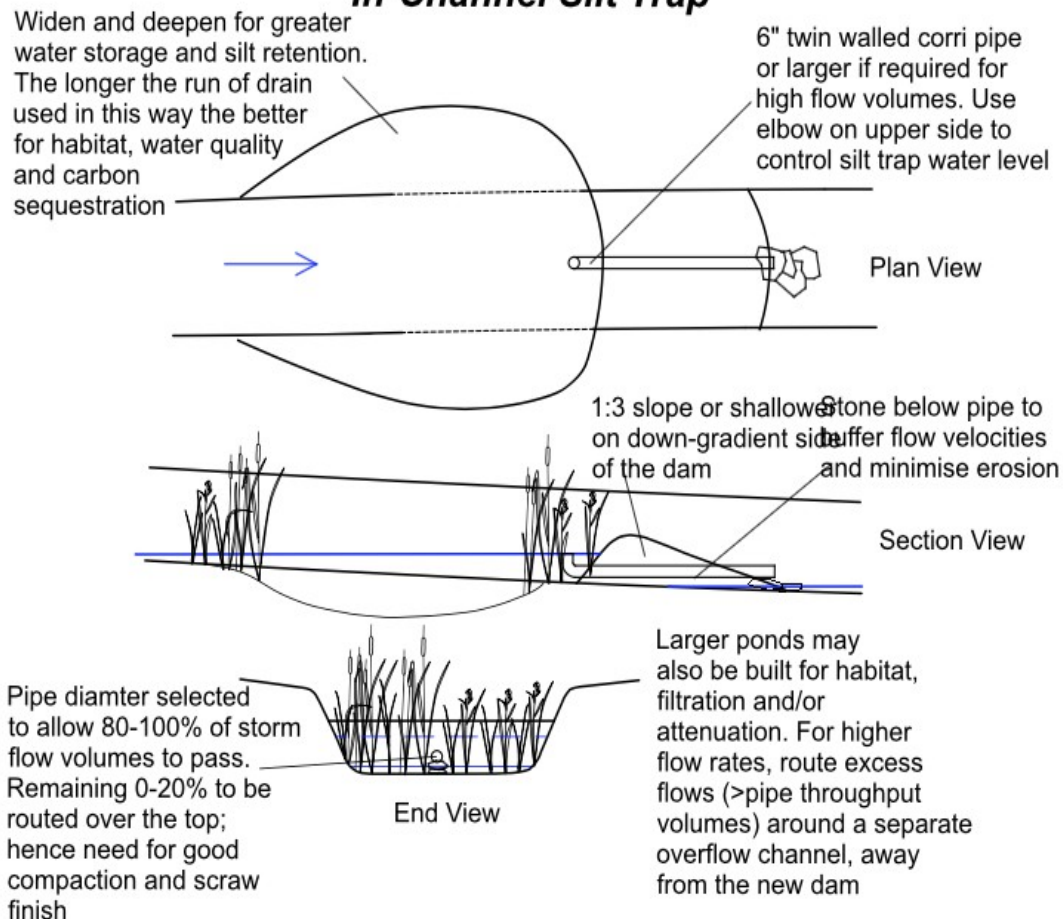
Even without using water on the farm, ponds are excellent for habitat value and for nutrient capture from farm runoff.

A synthetic liner will be needed where if soil is free draining.

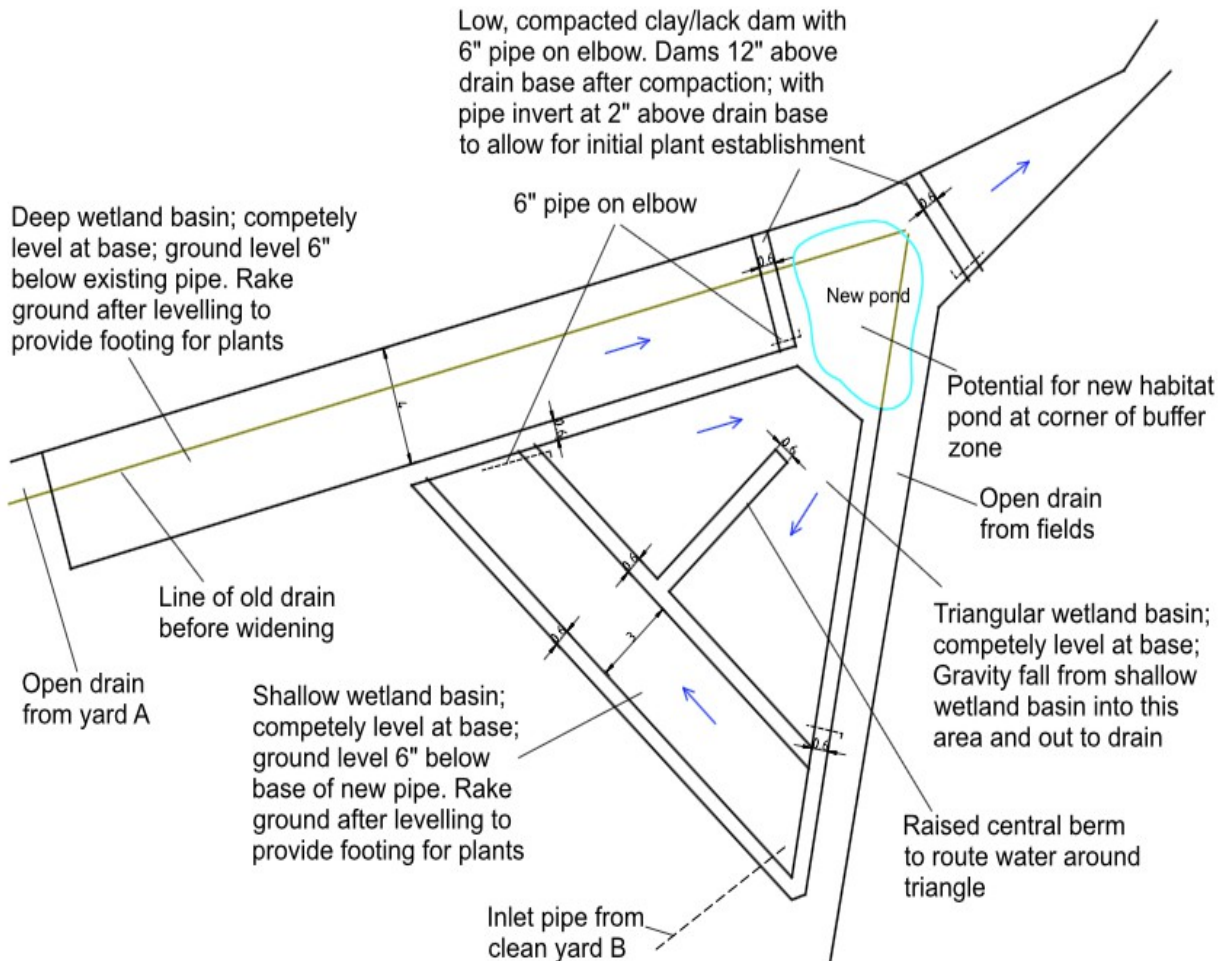
In-Channel Filter Buffers for Clean Yard Runoff



In-Channel Silt Trap



Example of Marsh Buffer Zone layout in awkward field corner - impermeable soils



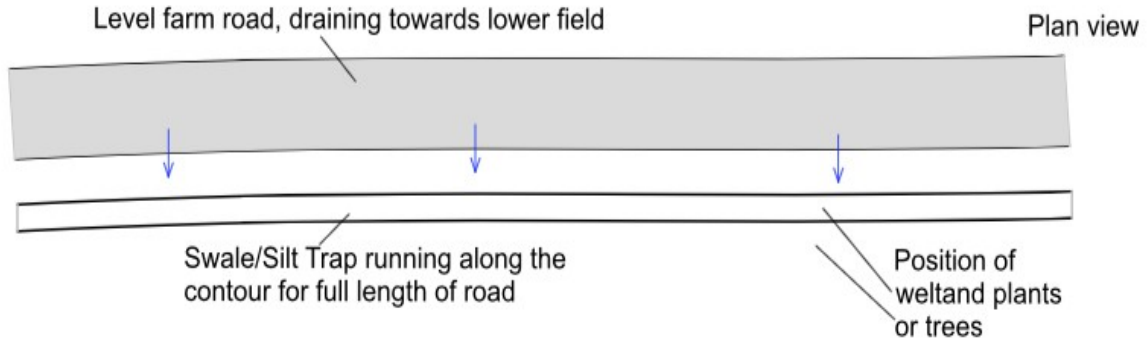
General works procedure

- 1 - Select an area downgradient of the yard, aiming for $\geq 10\%$ of the runoff area.
- 2 - Remove scraw and topsoil and spread on fields.
- 3 - Mould subsoil to required depth, length, width.
- 4 - Ensure drain base is level L-R and front to back.
- 5 - Build embankments at lower end of each drain section.
- 6 - Set pipe (size a function of projected throughput during storm event) just above drain base.
- 7 - Compact embankments well and top with scraw to minimise erosion during storm flow.
- 8 - Fit elbow at outflow side of pipe and set at minimum until plants have become established.
- 9 - Rake base to 6" depth to provide footing for plants.
- 10 - Plant with selected species of tall, broad leaved wetland plants such as bulrush, yellow flag Iris etc.
- 11 - Raise outlet pipe elbows to 6" water depth once plants are well established (1 month of green growth)
- 12 - Continue to ensure full storage/landspreading for soiled yard runoff, slurry, silage effluent etc.

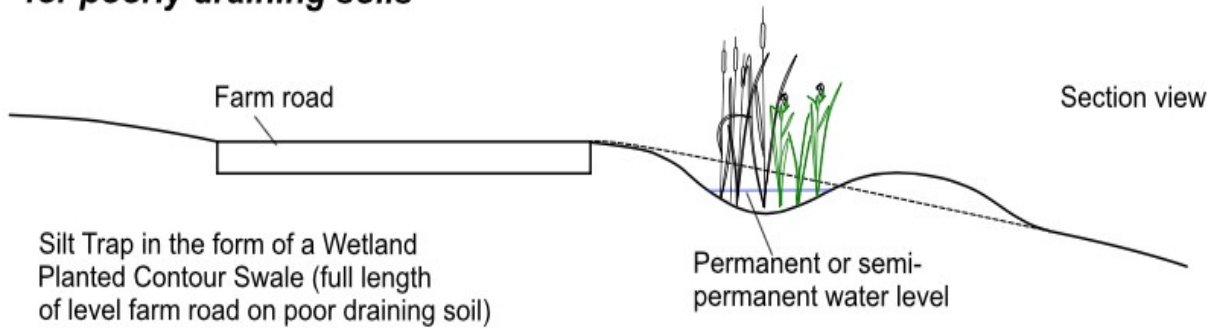
Note:

The measures here are for providing silt settlement and removal of straw and soil and other minor inputs from clean yard areas for overall improvement of water quality to filter runoff exiting well maintained, clean yard areas. If an ICW system (Integrated Constructed Wetland) is required for soiled yard runoff, parlour wash water etc, this will generally need 200% of yard area inclusive of roof surfaces; planning permission and a discharge licence. Refer to Dept of Ag. ICW guidance documents in that instance.

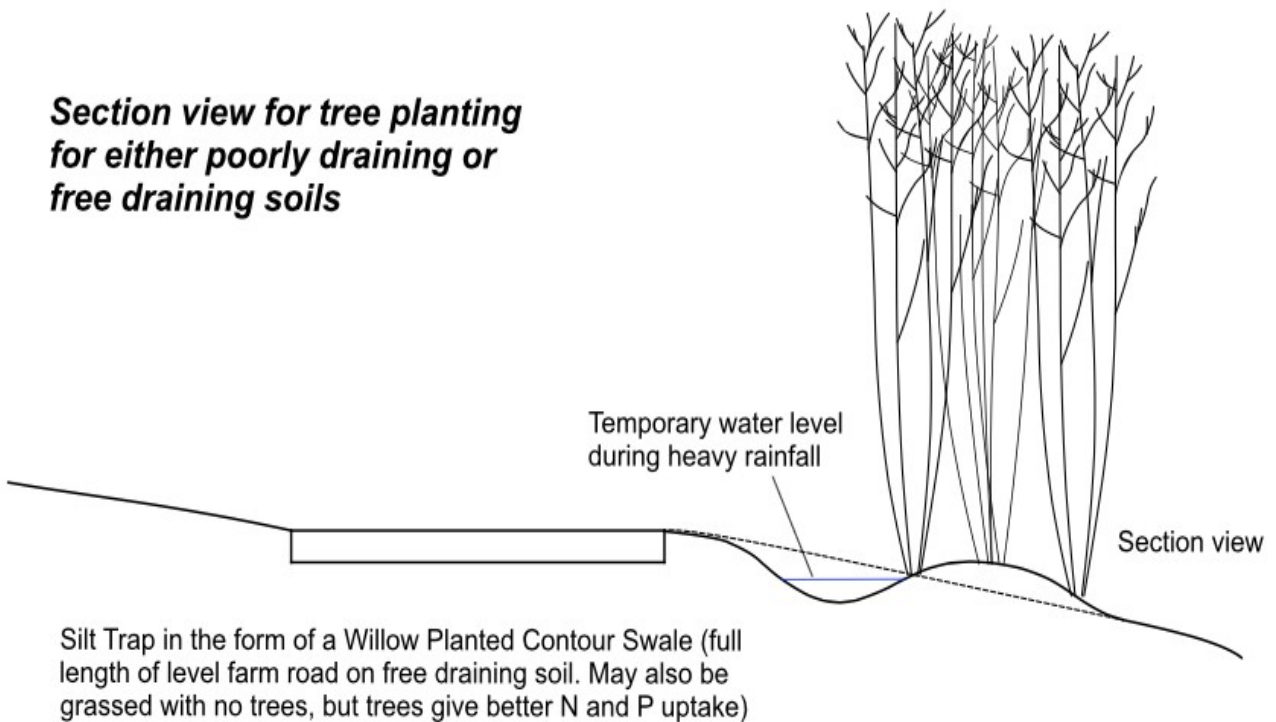
Silt Trap in the form of Contour Swales for runoff from level roads



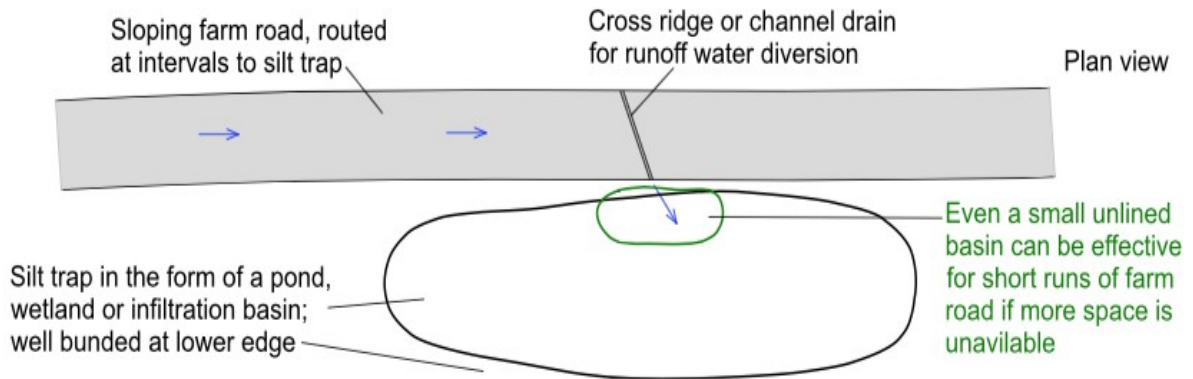
Section view for wetland planting for poorly draining soils



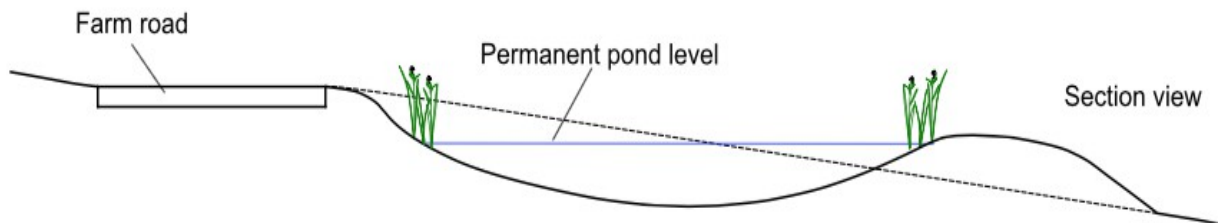
Section view for tree planting for either poorly draining or free draining soils



Silt Trap in the form of Settlement Basins/Ponds for runoff from Cross Ridges / Channel Drains from sloping roads

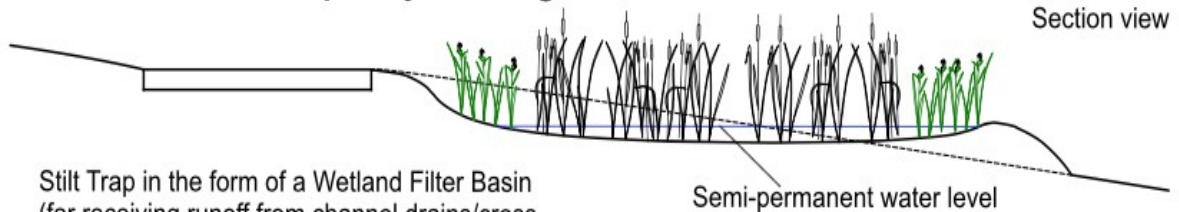


Filter pond on impermeable soils



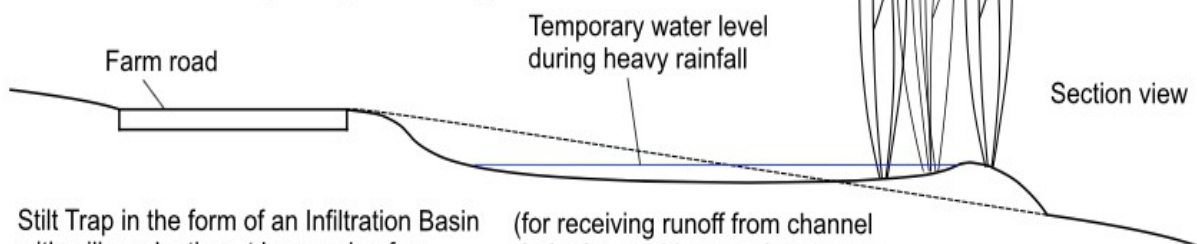
Stilt Trap in the form of a Settlement Pond (for receiving runoff from channel drains/cross ridges on sloping farm roads, for farms with poor draining soil. Clean overflow, if any, via planted drain to watercourse)

Marsh filter basin on poorly draining soils



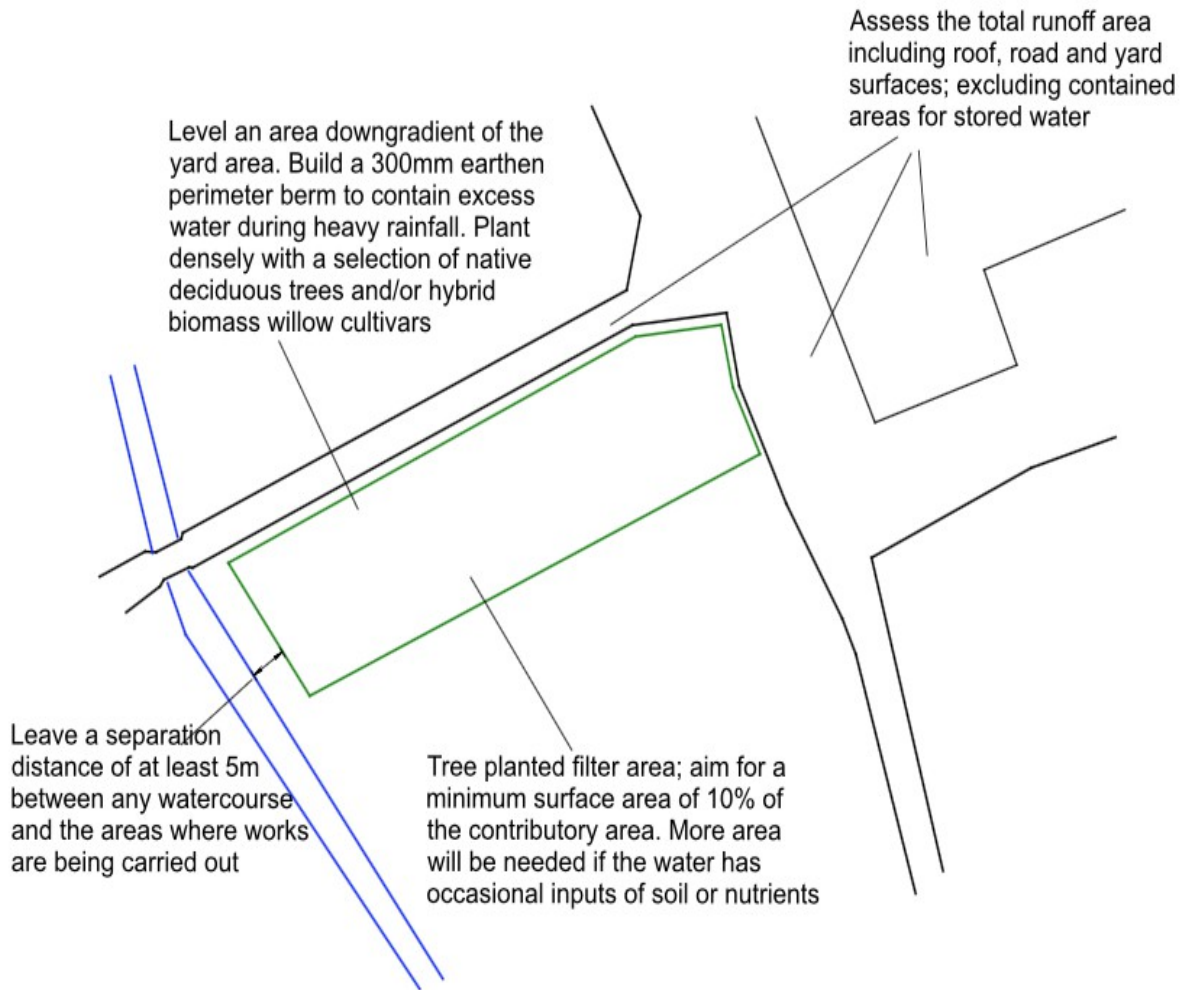
Stilt Trap in the form of a Wetland Filter Basin (for receiving runoff from channel drains/cross ridges on sloping farm roads, for farms with poor draining soil. Clean overflow, if any, via planted drain to watercourse)

Basin with tree planting on either free or poorly draining soils



Stilt Trap in the form of an Infiltration Basin with willow planting at lower edge for uptake of N and P. (for receiving runoff from channel drains/cross ridges on farm roads on farms with free draining soil)

Example of Wooded Zone Layout - free draining soils



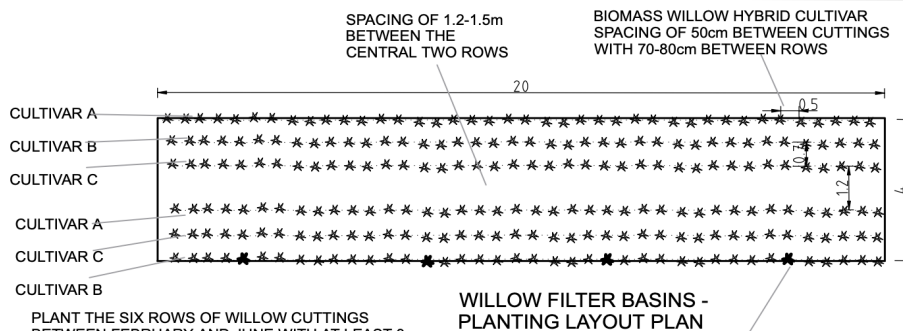
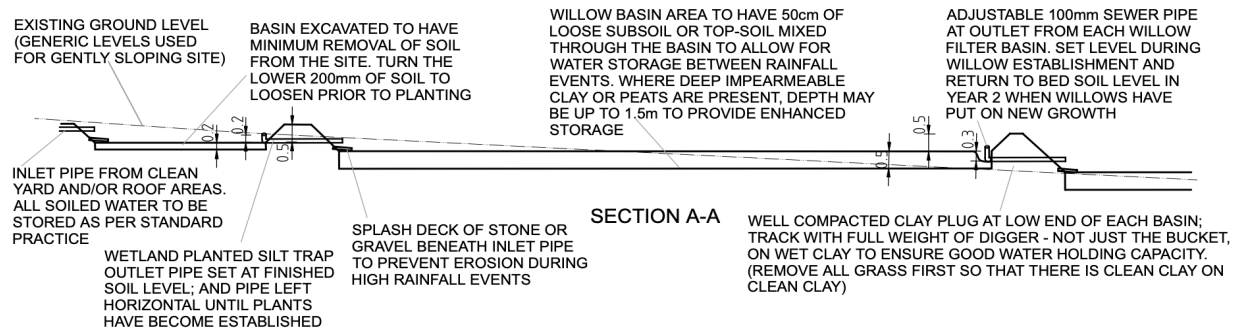
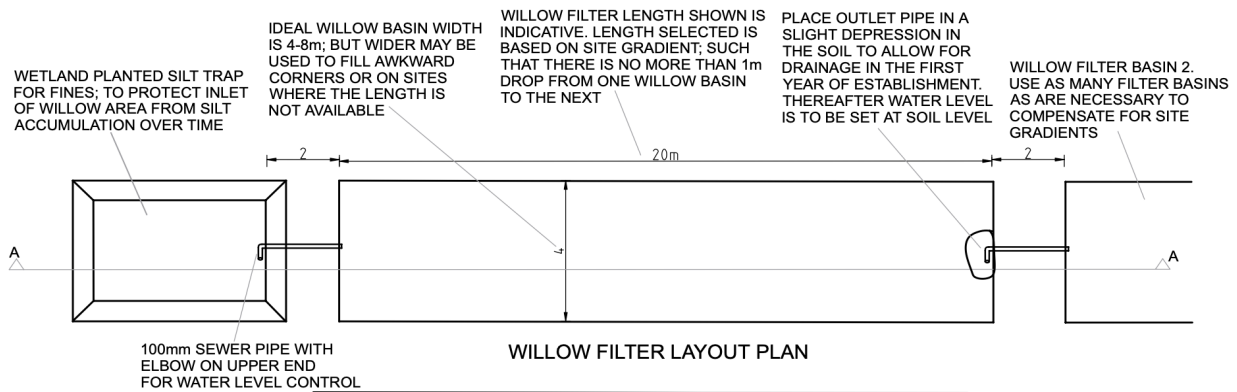
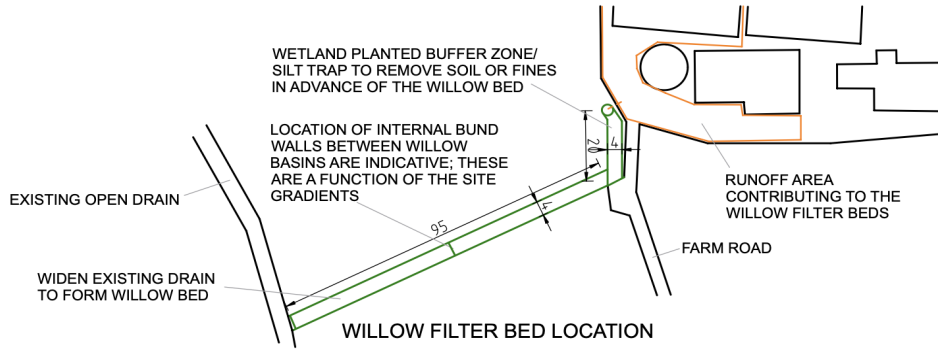
General works procedure

- 1 - Select an area downgradient of the yard, aiming for $\geq 10\%$ of the runoff area.
- 2 - Level the ground within a single basin or multiple basins, depending on gradient.
- 3 - Build a 300mm perimeter bund to contain water during heavy rainfall.
- 4 - Set up the distribution system to ensure a good spread of water across the planted area. This may be a pumped system with a piped distribution network; a gravity dosing system (such as via a Herr Flush Box from www.herr.ie); or channel distribution network. Note that no area should be $> 6\text{m}$ from a (shallow) channel or pipe outlet point.
- 5 - Route yard runoff into the basin area; or multiple basins. Ensure that there is a proportional basin area for each yard runoff area.
- 6 - Continue to ensure full storage/landspreading for soiled yard runoff, slurry, silage effluent etc.

Note:

The measures here are for providing silt settlement and removal of straw and soil and other minor inputs from clean yard areas for overall improvement of water quality to filter runoff exiting well maintained, clean yard areas. If an ICW system (Integrated Constructed Wetland) is required for soiled yard runoff, parlour wash water etc, this will generally need 200% of yard area inclusive of roof surfaces; planning permission and a discharge licence. Refer to Dept of Ag. ICW guidance documents in that instance.

Farmscale Willow Filter Bed for Clean Yard Runoff, Roof Surfaces and Farm Roads



PLANT THE SIX ROWS OF WILLOW CUTTINGS BETWEEN FEBRUARY AND JUNE WITH AT LEAST 3 DIFFERENT CULTIVAR TYPES. SUITABLE CULTIVAR VARIETIES OF *Salix viminalis* MAY INCLUDE JORA, TORR BJORN, SVEN, INGER, TORHILD, TORDIS OR OTHER NAMED BIOMASS HYBRIDS. DO NOT USE NATIVE WILLOWS OR BASKET WILLOWS SINCE THE GROWTH AND EVAPOTRANSPIRATION RATES WILL BE LESS EFFECTIVE THAN THE CULTIVATED VARIETIES

FOR OPTIONAL VARIATION IN PLANTING USE *Salix purpurea* (PURPLE WILLOW) OR *Alnus cordata* (ITALIAN ALDER) TREE FOR EVERY TENTH PLANT IN THE OUTER ROW OF TREES

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FARM SCALE WILLOW FILTER BEDS FOR CLEAN YARD RUNOFF, ROOF SURFACES AND FARM ROADS.

DESIGN SIZING AND LAYOUT

1. SIZE AT $\geq 10\%$ OF THE TOTAL CONTRIBUTORY CATCHMENT AREA. SEE ATTACHED DRAWINGS FOR INDICATIVE LAYOUT.
2. SELECT AN AREA DOWNGRADIENT OF THE FARMYARD/ROAD FOR GRAVITY FLOW.
3. IDEALLY KEEP THE SYSTEM WIDTH TO BETWEEN 4 AND 8m WIDE; BUT THIS MAY BE FLEXIBLE IF THERE IS AN AWKWARD CORNER THAT LENDS ITSELF TO USE AS A FILTER BED, BUT NOT CROP CULTIVATION.
4. PLACE A WETLAND PLANTED SILT TRAP BEFORE THE WILLOW BED FOR SUSPENDED SOLIDS RETENTION; SIZED AT APPROXIMATELY 10-20% OF THE WILLOW BED SIZE.
5. KEEP THE GROUND LEVEL WITHIN EACH BASIN LEVEL, LEFT TO RIGHT AND INLET TO OUTLET.
6. PLAN TO BUILD AND PLANT THE SYSTEM BETWEEN FEBRUARY AND APRIL; SO THAT WILLOW PLANTING CAN COMMENCE IMMEDIATELY UPON COMPLETION.

CONSTRUCTION NOTES

1. REMOVE TOPSOIL SCRAW (PLANTS AND ROOTS) AND SET TO ONE SIDE FOR REUSE IN THE BASE OF THE WILLOW FILTER. REMOVED REMAINING TOPSOIL AND SET TO ONE SIDE FOR REUSE IN THE BASIN.
2. MOULD THE SUBSOIL TO THE REQUIRED LAYOUT. ALLOW FOR A MAXIMUM DROP OF 1m BETWEEN BASINS; AND USE INTERNAL BUND WALLS TO DIVIDE THE AREA AVAILABLE INTO SEPARATE BASINS WHERE GRADIENTS REQUIRE IT.
3. TRACK BACK AND FORTH OVER MOIST CLAY FOR ALL MADE GROUND. THIS IS MORE EFFECTIVE THAN SIMPLY COMPACTING WITH THE BUCKET OF THE DIGGER. IT IS IMPORTANT THAT ALL WATER REMAINS IN THE WILLOW BASIN UNTIL IT REACHES THE FINAL OUTLET POINT AND DOES NOT SPILL OUT OVER THE FIELD OR OTHER AREA.
4. DIG OUT THE WILLOW FILTER BASIN TO A DEPTH OF 50cm (OR UP TO 1.5m WHERE DEEP CLAYS OR PEATS ARE PRESENT TO PROTECT GROUND WATER).
5. REPLACE TOP SCRAW (UPPER AREA OF TOPSOIL) INTO THE BASE OF THE WILLOW FILTER. REPLACE LOOSE SUBSOIL OVER THIS. FINALLY REPLACE THE WEED-FREE TOPSOIL ACROSS THE UPPER LEVEL OF THE WILLOW BASIN.
6. SEED PERIMETER EMBANKMENTS WITH GRASS/CLOVER MIX OR A NATIVE IRISH WILDFLOWER MIX TO MINIMISE RAINFALL EROSION OF THE BANKS.
7. LET OUTLET PIPES HORIZONTAL TO ALLOW FREE FLOW OF WATER THROUGH THE BASINS. THIS MAY BE RAISED ONLY AFTER THE WILLOWS HAVE BECOME WELL ESTABLISHED - EITHER IN APRIL OF YEAR 2, OR EARLIER IF NEEDED TO HOLD A BIT MORE MOISTURE DURING A DRY SUMMER IN YEAR 1.
8. KEEP THE WILLOWS WEED-FREE IN YEARS 1 AND 2. THEREAFTER THE WILLOW GROWTH WILL KEEP WEEDS DOWN. DO NOT USE HERBICIDES, WHICH CAN BE READILY ABSORBED BY THE WILLOW STEMS EVEN IN WINTER, KILLING YOUR WILLOWS.

9. FOLLOW PLANTING AND COPPING NOTES ON THE PLANTING LAYOUT DRAWING.

PLANTING AND COPPING NOTES FOR WILLOW FILTER

- ☐☐ LOWER ANY HEDGE LINES WITHIN 5m OF THE WILLOW FILTER TO MAXIMISE THE EXPOSURE TO LIGHT AND WIND TO MAXIMISE EVAPOTRANSPIRATION AND EFFLUENT UPTAKE. KEEP MAINTAINED ON AN ONGOING BASIS.
- ☐☐ WILLOW TREES ARE TO BE COPPED ON A 3-YR ROTATION BASIS AS SET OUT BELOW:
 - ☐☐ 1st FEBRUARY AFTER PLANTING: CUT BACK ALL TREES TO 150mm ABOVE BED LEVEL TO ENCOURAGE STEM DEVELOPMENT.
 - ☐☐ 2nd FEBRUARY AFTER PLANTING: LEAVE ALL WILLOWS UNCUT.
 - ☐☐ 3rd FEBRUARY AFTER PLANTING: CUT BACK ALL THREE ROWS ON ONE SIDE OF THE FILTER AREA TO 100mm ABOVE THE PREVIOUS CUT.
 - ☐☐ 4th FEBRUARY AFTER PLANTING: CUT BACK ALL THREE ROWS ON THE OTHER SIDE OF THE FILTER AREA TO 100mm ABOVE THE PREVIOUS CUT.
 - ☐☐ 5th FEBRUARY AFTER PLANTING: LEAVE ALL WILLOWS UNCUT.
 - ☐☐ 6th FEBRUARY AFTER PLANTING: REPEAT CYCLE FROM 3rd YEAR.
- ☐☐ COPPING MAY BE CARRIED OUT WITH A LOPPERS OR BRUSH CUTTER OR TRACTOR MOUNTED HEDGE CUTTER. REMOVE CUT TREES FROM THE AREA AND STORE AWAY FROM DRAINS TO PREVENT RE-ENTRY OF NUTRIENTS INTO WATERCOURSES. TIMBER MAY BE CHIPPED OR LOGGED FOR FUEL, USED AS A WILDLIFE HABITAT LOG-PILE, OR FOR LANDSCAPING.
- ☐☐ NOTE THAT IF FIREWOOD IS DESIRED, LEAVE CUTTINGS TO GROW FOR 5 YEARS RATHER THAN 3, AND ALLOW CUT LENGTHS TO DRY FOR 2 YEARS PRIOR TO LOGGING FOR FIREWOOD.

PLANTING NOTES FOR WETLAND PLANTED SILT TRAP

1. PLANTING SHOULD BE CARRIED OUT IN THE SPRING, PRIOR TO OR APPROACHING THE GROWING SEASON; AND USUAL PLANT CARE ADHERED TO.
2. THE WETLAND AREA(S) SHOULD BE PLANTED WITH LARGE GROUPS OF SINGLE SPECIES OF TALL EMERGENT SPECIES TO PREVENT THE DOMINANT SPECIES COVERING THE WHOLE AREA. PLANT SPECIES LISTED ARE INDICATIVE AND MAY BE AMENDED WITHIN CERTAIN LIMITS.
3. THE MAIN TALL PLANTS SHOULD BE PLANTED AT c.0.7m SPACING (2 PLANTS/m²). SEEDING MAY ALSO BE USED, BUT WILL TAKE LONGER TO BECOME ESTABLISHED.
4. GROUND COVER SHOULD BE ESTABLISHED AS SOON AS POSSIBLE AFTER TOP-SOIL REPLACEMENT ON BANKS. USE GRASS/CLOVER MIX OR NATIVE IRISH WILDFLOWER SEED SUCH AS FROM WILDFLOWERS.IE .
5. ENSURE THAT TREES (OTHER THAN WILLOWS IN THE WILLOW FILTER OR SMALLER HEDGEROW TREES) ARE NOT LESS THAN 4m FROM THE SILT TRAP TO PROTECT THE INTEGRITY OF THE CLAY LINED BASE. WEED OUT TREE SEEDLINGS IF FOUND.
6. WATER SHOULD BE KEPT JUST BELOW MARSH SOIL LEVEL UNTIL PLANTS ARE FIRMLY ROOTED AND GROWING WELL, TO PREVENT THEM FLOATING AWAY. A FEW WEEKS OF GROWING SEASON GROWTH SHOULD BE

SUFFICIENT FOR ROOTED PLANTS. LONGER WILL BE NEEDED FOR SEEDED AREAS.

7. THE WATER LEVELS SHOULD BE SUFFICIENT TO KEEP THE MARSH SOIL MOIST. IF THE SYSTEM IS SHOWING SIGNS OF DRYING OUT, WATER WELL, WITH THE OUTLET FLOW CONTROL PIPE RAISED UP TO ENOUGH HOLD WATER AT BASE LEVEL.
8. FOR THE FIRST FULL YEAR, KEEP WATER LEVEL AT ≤ 10 cm DEPTH. IN MAY OF YEAR 2, LEVELS MAY BE RAISED TO 20cm OPERATING DEPTH.

Recommended plants for wetland planted silt trap:

Iris pseudacorus - yellow flag

Mentha aquatica - water mint

Nasturtium officinale – watercress

Typha latifolia - bulrush

Sparganium erectum - branched burr reed

Essentially any tall, flat-leaved, emergent wetland plants are typically suitable for use in wetland planted silt traps or buffer zones. If these are present on the farm, harvest by hand and use in preference to buying in stock. Plants available from FH Wetland Systems if needed.

Further Information

Contact FH Wetland Systems for additional background information on farm or community scale ponds; SUDS units for urban runoff; training and workshops on water quality and environmental protections; or resources on natural wastewater treatment technologies such as reed beds and constructed wetlands.

www.wetlandsystems.ie