# Silt & Sediment Mitigation Guidelines for Forest Operations

## *'Slow the flow and retain sediment on site'*

## 1. SCOPE

These guidelines relate to silt and sediment management and control practices to be adopted on forest operations sites, with a particular focus on protecting water quality within and exiting the site.

Silt is a general term for fine sand, clay, or other eroded soil material carried by flowing water and deposited as a sediment in the watercourse bed or lake bottom. It is a naturally occurring material that can be caused by weathering or erosion which is essential for a well-balanced aquatic ecosystem.

However, a wide range of land management activities can increase soil erosion. In the case of forest operations, site disturbing operations, such as road works, harvesting and cultivation, combined with heavy rainfall, pose a high risk of silt runoff into waterways if not properly managed and controlled.

The impacts of silt and sediment on a waterbody can lead to a significant decrease in water quality, impacting negatively on aquatic habitat, fish and other aquatic organisms' population numbers and restrict the potential use as a water supply for animals or humans.

## 2. PURPOSE

The primary purpose of these guidelines is to ensure that the most appropriate silt and sediment mitigation measures are implemented during forest operations.

Determining the best silt prevention and mitigation measures are based on the results of the environmental risk assessment (ERA) of the proposed forest operation, taking account of site factors such as, soil type and its erodibility potential, slope, presence of watercourses and site drainage patterns.

These guidelines outline the specific roles of the (Business Area Unit) BAU forest operations staff and contractors in the application of ERA STANDARD and SITE-SPECIFIC mitigations regarding silt management for specific forest operations. Both sets of mitigations list a suite of factors to be considered and appropriate mitigations that can be used. Additional guidance is provided on identified high risk site factors, illustrating good practice with a series of photographs throughout the document.

By strict adherence to these guidelines, you will ensure compliance with Coillte's forest operation requirements and Department of Agriculture, Food and the Marine Forest Standards.

## 3. IMPORTANCE OF SILT & SEDIMENT CONTROL

### 3.1. Managing Environmental Risk

- Silt run-off into receiving waters is a significant environmental risk associated with forest operations and largely arises from soil disturbance and tracking of forest machinery across the site, leading to erosion of exposed soils by surface water runoff unless mitigated and controlled.
- Controlling a pollution event at source i.e. preventing it from happening in the first place is key to good silt and sediment management.
- The protection of vegetated cover and minimisation of site disturbance minimises silt losses. It is important to facilitate the establishment of new vegetation on bare ground at the earliest opportunity.
- Identifying key areas on a forest site that require protection is another important aspect of planning, these include:

- Watercourses (i.e. relevant watercourses and aquatic zones)
- Drainage channels
- Watercourse crossing points
- Hotspots (including wet unplanted areas, flushes or springs, windblown areas, floodplains and portions of a site where there are complex networks of drain channels).
- Forest road drainage systems
- Downstream lakes

- A helpful tool in conducting this assessment is to use the source-pathway-receptor model to identify and mitigate the risk.

| Source | Pathway | Receptor | Mitigation |
|---|---|---|---|
| Forest operations entailing soil disturbance | Surface waterflow into adjacent drains and relevant watercourses | Aquatic zones | Silt trap(s) located near to silt source |

- Mitigations such as silt traps should be applied in a structured manner and preferably be installed at source, along the pathways and before the setback of the receptor (e.g., aquatic zone), see Appendix I.
- Heavy rainfall can dramatically increase surface water runoff and operations should move to a drier section of the forest operations site or cease when such situations occur.
- Completion of an ERA relating to the protection of Water & Soils during forest operations is essential in preventing impact on water quality, ensuring compliance with regulatory and forest certification requirements and minimising risk of prosecution, with the potential of penalties and reputational damage.

## 3.2 Completion of an ERA

- A good ERA that identifies appropriate erosion and silt controls provides many benefits including:
  - the protection of soil and water quality.
  - ensuring forest operations proceed in a controlled and timely manner.
  - complying with Coillte and Forest Service certification and regulatory requirements.
  - providing confidence that the site is managed to the highest standards.

## 4. RESPONSIBILITY

### 4.1 BAU Forest Works Manager (FWM) or Project Designer (PSDP)

- Forest Operations sites that are 'wet' and/or 'at risk' should be ideally scheduled for summertime when the water-table is at its lowest – and even then, in periods of wet weather, it may be necessary to suspend operations or move sites.
- FWM or PSDP will brief the relevant contactors on the environmental sensitivities of the site based on the ERA Checklist and ERA Form in the Site Activity Pack. Note should be taken of the following:
    - During the initial site survey identify the location of all aquatic zones, relevant water courses and field drains.
    - If additional features are present, capture these on the field capture device (FDCD) to ensure a record is generated on LRM & update the site activity pack.
    - FWM of each forest operation must verify the classification of the watercourses collected for each site.
- The FWM or PSDP should familiarize themselves with specific Felling Licence special conditions related to the operation.
- Both FWM or PSDP and Contractor will agree on who will install and maintain the silt mitigations (i.e. the main or estates contractor).
- The FWM or PSDP must agree with the Contractor where the mitigations should be implemented, note a selection of different types of mitigations can be implemented on site. Where any significant change in site conditions and/or deterioration in weather occur, additional remedial measures must be agreed between operators and BAU staff.
- For GREEN rated sites, agree with contractor the standard mitigations that apply on each site as detailed in the *ERA Mitigations – STANDARD (ENGINEERING, HARVESTING OR ESTABLISHMENT).*
- BLUE & RED rated sites may require additional Site-Specific Mitigations that will be stated in the ERA in the Site Activity Pack with mitigations agreed with contractor.
- *Irrespective of the site rating, adherence to the Felling Licence site/operation specific conditions are mandatory.*

### 4.2 Contractor/ Project Supervisor Construction Stage (PSCS)

- It is the responsibility of the Contractor/PSCS to implement Standard Mitigations [ERA Mitigations – STANDARD (ENGINEERING, HARVESTING OR ESTABLISHMENT) (mandatory) and SITE SPECIFIC (ENGINEERING, HARVESTING OR ESTABLISHMENT)] (where required)].
- The Contractor/PSCS will complete the daily visual site monitoring form on sites where there is an impact and significant risk to water quality and take remedial action.

- The Contractor/PSCS should flag issues regarding silt run-off and adequacy of current measures during site visits by FWM or PSDP and agree remedial measures.
- Report immediately to the FWM or PSDP any incident of significant ground disturbance leading to siltation of adjacent watercourses.

## 5. REFERENCES

- SOP-041_Environmental Risk Assessment (ERA) Procedures for Site Operations [2018]
- ER-024_ERA_Mitigations_STANDARD_HARVESTING
- ER-025_ERA_Mitigations_SITE_SPECIFIC_HARVESTING
- ER-028_ERA_Mitigations_STANDARD_ESTABLISHMENT
- ER-029_ERA_Mitigations_SITE_SPECIFIC_ESTABLISHMENT
- ER-026_ERA_Mitigations_STANDARD_ENGINEERING
- ER-027_ERA_Mitigations_SITE_SPECIFIC_ENGINEERING
- SOP-009 Emergency Preparedness and Response Procedure
- Coillte Internal Forest Operations and Water Protection Guidelines [2011]
- COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads. 2nd Edition. [2005].
- EU funded INTERREG VA Source to Tap - Forestry Pilot, How-To Guide: Geotextile Dams [2021]
- Environmental Requirements for Afforestation [2016]
- Standards for Felling & Reforestation, DAFM-FS [2019]
- Forest Standards Manual, DAFM [2015]
- Managing forest operations to protect the water environment, Forest Research [2019]
- CIRIA C741, Environmental good practice on site guide (fourth edition) [2015]

## 6. FOREST OPERATIONS MITIGATIONS

The **ERA STANDARD Mitigations for Engineering, Harvesting & Establishment** specifies the measures that must be implemented as standard on the respective forest operations sites. Specific Standard Mitigations have been identified in Tables 6.1, 6.3 and 6.5 for Engineering, Harvesting and Establishment and refer specifically to Silt & Sediment Control. These Mitigation measures should be regarded as standard best practice in relation to Silt and Sediment Management.

***There is no need to list the STANDARD Mitigation measures in the Site File ERA***.

However, the FWM or PSDP, when agreeing the site plan with the contractor/PSCS in advance of operations, should discuss fully both the Standard and site specific mitigations that need to be applied to each site.

Additional guidance is provided under some of these measures to ensure best management practices are adopted - see **Tables 6.1, 6.3 & 6.5.**

Regarding the **ERA SITE- SPECIFIC Mitigations for Engineering, Harvesting and Establishment,** they list optional measures that may be implemented on such sites if it

is judged that the Standard Mitigations will not be sufficient to adequately manage silt run-off from the site – see **Tables 6.2, 6.4 & 6.6.**

They have been augmented by other measures and/or guidance that have been used to good effect by harvesting teams across the BAUs on environmentally sensitive sites in recent years. If additional site-specific measures are required:

***It is essential to list SITE-SPECIFIC Mitigation measures in the Site File ERA.***

The FWM/PSDP should discuss fully with the contractor/PSCS the Site-Specific Mitigations that need to be applied to each site. This discussion should take place in advance of operations.

Regarding silt trap maintenance,

- Review site to determine if additional silt traps are required.
- Review existing silt traps to ensure that anchor points are secure and that silt traps are working efficiently.
- Do not allow silt traps to become overloaded with silt and sediment.
- Sediment should be emptied from the trap when half to three quarters full. This should be deposited away from any adjacent watercourse.

## 7. Monitoring and Sign-Off

Silt control measures along all relevant watercourses and aquatic zones and water crossings should be checked during site monitoring and their condition and requirement for maintenance recorded by the FWM/PSDP using the field data capture device (FDCD). In the event of a significant rainfall event, record the stopping of operations and/or the movement of machines to a drier part of the operations site. Where additional or alternative mitigation measures are required see Site Specific Mitigations (Tables 6.2, 6.5 & 6.6 below).

Before forest machinery leave the site, all risk of siltation should be checked to ensure that:

- All water courses and water crossings are running clear and temporary crossing points are adequate.
- Record the status of the flowing water on the Daily Visual Water Monitoring Form.
- Post forest operations site monitoring should be undertaken until all risks have been reduced.

If there are persistent issues with the contractor/PSCS regarding silt management, consideration must be given to recording on the Breach Register with an appropriate sanction (site amelioration, ERA re-training, etc.).

## 8. Auditing and Reporting

Active operational sites will be randomly audited by the Environment, Social and Governance Quality Assessor Team, using EMS SOP - 026 Internal Audit Procedure. The findings of these audits will be communicated to the BAU and close out action plans uploaded and tracked out on the EcoOnline EHS.

## 9. Emergency Preparedness & Response Procedure

Where an environmental incident occurs, EMS SOP - 009 Emergency Preparedness & Response Procedure should be followed by BAU & ESG staff.

## 10. Revision History

| Revision # | Change details | Reason for change | Date |
|---|---|---|---|
| 1.0 | Drafted initial guidelines | N/a | 20/11/2022 |
| 1.1 | Replaced reference to SRA to ESG, minor update to the references, updated text in Section 4, Updated Table 6.1 Culverts, Table 6.2, Figures 12 & 13. Table 6.4, Figures 16 & 17. Insertion of Appendix 1 and Appendix 2, Section 1.6 - Silt Trap Type B & Section 1.10 - Leaky dams. | Feedback from BAU operations staff | 26/06/2023 |
| 1.2 | Updated text in 1.10 Log / Leaky dams and inserted additional photos in Figure 22. | Feedback from Environmental Managers following completion of silt & sediment training courses | 01/11/2023 |
| 1.3 | Updated watercourse definitions | DAFM clarification | 16/12/2024 |

### TABLE 6.1 ERA STANDARD MITIGATIONS – ENGINEERING GUIDANCE FOR SILT & SEDIMENT CONTROL

The following table presents the Standard Mitigations that refer to silt & sediment control and overall approach to erosion and sediment control and management related to road construction.

**Aquatic Zones & Relevant Watercourses**

27 Do not install silt traps on or within the buffer of an aquatic zone.
28 Do not excavate roadside drains directly into aquatic zones or relevant watercourses.
29 All roadside drains to have silt traps installed at relevant locations.
30 Install silt traps close to potential sources of silt runoff.
31 Do not remove gravel from aquatic zones or buffer zones.

**Setbacks or Exclusion zones (otherwise known as buffer zones)**

32 No machinery operations to take place in the exclusion zones unless unavoidable and justified in plan.

**Silt traps**

33 Monitor silt traps and install additional traps if necessary.
34 Place material taken from silt traps as far away as possible from water flow.
35 Ensure that all silt traps are fully functional before removing machinery from site.

**Weather**

36 Suspend forest operations during periods of heavy rainfall or move to a less sensitive part of the site.

***Weather – Additional Guidance***

a) *Ensure that the most sensitive areas of the site take priority during dry weather.*
b) *Select the most appropriate time to conduct forest operations to suit site conditions, noting that winter harvesting has the shortest days, the most precipitation and poorest drying conditions.*
c) *During heavy rainfall events the risk of overland silt runoff increases significantly which requires the need to install further mitigation measures.*

**Monitoring**

37 Daily visual water monitoring is required on all BLUE and RED sites, and on GREEN sites where deemed necessary by Coillte FWM/PSCS.

**Pollution Control & Emergency Response**

38 Pollution control kit on all sites.
39 Implement pollution control procedures in the event of siltation of water, oil or chemical spill and report to manager.

**Table 6.1,** continued

***Additional Guidance***

***Site survey and additional planning (prior to licence application)***

- *Identify the construction activities that may effect water quality on site.*
- *Remove or reduce the risks by:*
  - *Amend the route layout to avoid the exclusion zone around watercourses and other recorded environmental features.*
  - *Consider using alternative construction methods for the construction type, such as build on top method versus excavation.*

***Erosion and sediment control in road construction***

*Principles of erosion and sediment control are as follows:*

- *Erosion control is much more effective than sediment control in preventing water pollution.*
- *Plan erosion and sediment controls early in the project and incorporate them into the works programme.*
- *Where possible install drainage and runoff controls at the beginning of any construction works.*
- *Roadside drainage should not intercept runoff from higher ground.*
- *Run off from higher ground should be culverted under the forest road as soon as possible as to not to disturb the direction on the flow too much.*
- *During operations, review existing silt mitigation measures to ensure they are adequate and amend or install further measures where required.*

***Further standard mitigations guidance***

- *Dissipate surface water flow at regular intervals. over vegetated land (i.e. buffer strips) without potentially causing further impacts elsewhere. Buffer strips are zones of natural vegetation through which the water passes and in so doing deposits sediments.*
- *When cleaning roadside drains, avoid cleaning out drain vegetation unnecessarily. Leave undisturbed sections of vegetation to trap sediment (i.e. 10 m plus).*
- *Minimise the area of exposed ground on site by stripping vegetation and topsoil only when needed, rather than well in advance.*
- *Provide appropriate control and containment measures on site.*
- *Monitor and maintain erosion and sediment controls throughout the project.*
- *Plan to establish vegetation as soon as possible on all exposed soil.*

***Standard water control measures to be employed during road works***

| | |
|---|---|
| **Roadside drains**<br><br>These are provided at the edge of the forest road. They are channels for conveying storm water away from roads and there to protect the road formation from erosion.<br><br>Occasionally a deeper drain may be required where a high water-table persists at the location where the forest road is constructed. |  |
| | Figure 1. Series of silt traps in roadside drains |

**Table 6.1,** continued

**Culverts**

Roadway culverts will be for two purposes;

- conveyance of run-off from uplands
- the periodic removal of run-off from the formation before it can give rise to structural weakening or erosion.

The outflow drainage water can pass through a mechanical sediment trap prior to dissipating over a vegetated buffer strip.

**Note Avoid hanging culverts at fish bearing AZs.**

Figure 2. Culvert outflow where silt laden drainage water is mitigated by a mechanical sediment trap and silt trap.

**Note:**

1. Culvert Sizing:

Culverts are to be of a size adequate to carry expected peak flows, appreciation should be given to extreme rainfall events Consideration should be given to installing larger culverts as standard especially on upland and steep slope sites, see Appendix IV.

2. Culvert Spacing:

Culvert spacing will vary from 40 metres to 100 metres depending on road gradient, the amount of rainfall, steepness of the terrain and susceptibility of the soil to erosion. The proximity of culverts increases with steeper road gradient and the erosion risk. The effectiveness of culverts depends very much on their correct spacing. A table to serve as a guideline to the correct spacing of the culverts has been provided in Appendix III.

In order to keep culverts functioning effectively, they should be installed at a similar level as the watercourse channel (see Figure 2.)

**Erosion Control**

Erosion control is intended to prevent runoff from the road become a source of siltation into receiving relevant watercourses and aquatic zones.

Therefore, mechanical sediment traps are constructed in the roadside drain, usually excavating a hole that is constructed large enough to slow the water so that the coarse sediment can settle on the bottom (see Figure 3).

Figure 3. Roadside mechanically installed sediment traps in a series (Source: DAFM).

**Table 6.1,** continued

| | |
|---|---|
| **Water cut-offs**<br><br>Where the topography of the forest results in a fall away from the forest road on the down hillside of the new road, water cut offs should be constructed ever 10-15m. The aim of these is to dissipate any surface water into a vegetated buffer strips and to avoid situations where large volumes of water could potentially be transported down the forest road drainage network. |  <br>Figure 4. Water cut-off leading to a buffer strip/soakaway located down slope of the forest road. |
| **Crossing Relevant Water courses and aquatic zones**<br><br>Any relevant watercourse or aquatic watercourse that is intercepted by a road will be culverted or bridged at that point.<br><br>The installation of culverts are time of year specific and the method of installation should take account of the local site conditions. The most common method is to install at low water flow, ensuring silt capture downstream of the works area. Other methods include the use of water pumps to divert the water over the culvert area or to block and temporary divert the relevant watercourse or aquatic zone.<br><br>The road designer will need to ensure suitable sizing of culverts please reference Appendix IV.<br><br>**Note:** Most aquatic zones crossings will need IFI approval, which will include the requirement for site specific method statements. |  <br>Figure 5. Relevant watercourse crossing using a culvert with silt mitigation using a combination of a mechanical sediment trap and silt trap downstream. |

**Silt Traps**

In addition to erosion control, silt traps should be installed at regular intervals in roadside drains and a culvert outfalls. Silt traps should be constructed from a non-woven geotextile.

| | |
|---|---|
|  <br>Figure 6. Silt traps installed in series in a roadside drain. |  <br>Figure 7. Mechanical sediment trap and silt trap in series. |

### TABLE 6.2 ERA SITE-SPECIFIC MITIGATIONS – ENGINEERING GUIDANCE FOR SILT & SEDIMENT

The following table presents the SITE-SPECIFIC Mitigations that refer to silt & sediment control and provides additional guidance on some of these, i.e. Mitigation No.'s 20 to 23.

**Water Crossings**

19 Specify location and number of Water Crossings on Aquatic Zones & relevant watercourses.

***Additional Guidance – Aquatic Zone Crossings***

As part of the licensing process, there may be a requirement to consult with Inland Fisheries Ireland to obtain an agreement for the construction of a road across selected aquatic zones.
In these cases an individual method statement must be agreed with IFI before construction commences.

Figure 8. Cross span bridge over an aquatic zone.

**Silt Control**

20 Specify the number & locations of silt traps (mandatory on blue & red water sites).
21 Upgrade existing silt traps.
22 Decommission the silt traps that are no longer required.
23 Specify post operational maintenance plan (following completion of the operations the condition of watercourses & silt traps should be assessed & a post operation maintenance plan drawn up).

***Additional Guidance - Silt control***

- *On sensitive sites, (such as steep sites or sites with gley, peaty gley and peat soils that have high erodibility potential), there may be a requirement to construct additional silt control measures, which would include enhanced silt traps, the use of silt curtains, aquatic zone crossings and the construction of attenuation ponds/ soakaway areas. Site specific silt control measures will also be required where an aquatic zone will be crossed.*

Figure 9. Enhanced silt curtain retaining silt laden surface water.

Figure 10. Example of an attenuation pond, considered where there is limited opportunity to divert water to a localised soakaway (Source: DAFM).

**Table 6.2,** continued

***Additional Guidance - Silt control continued***

- *If in limited circumstances the road design cannot eliminate construction close to or in the set back of an aquatic zone due to the nature, topography or characteristics of the site, silt curtains should be installed parallel to the construction works.*

Figure 11. Silt curtain is in place to protect the aquatic zone while road construction is ongoing.

Figure 12. Another example of a roadside silt curtain.

Figure 13. 3” or 4” clean washed stone placed in roadside drain.

Figure 14. 3” or 4” clean washed stone placed in roadside drain with geotextile silt trap on the outflow.

### TABLE 6.3 ERA STANDARD MITIGATIONS – HARVESTING GUIDANCE FOR SILT & SEDIMENT CONTROL

The following table presents the Standard Mitigations that refer to silt & sediment control and provides additional guidance on some of these, i.e. Mitigation No's 41, 50/51 & 53.

**Aquatic Zones & Relevant Watercourses**

33 Do not install silt traps on or within the exclusion zone of an aquatic zone.

**Exclusion Zones**

35 Standard exclusion zones along all aquatic zones is 10m.

36 No machinery operations to take place in the exclusion unless unavoidable and justified in plan.

**Water Crossings**

41 Minimise crossing watercourses. Where watercourses must be crossed, bridge by placing logs at right angle to flow of water and cover with brash or insert plastic pipe and cover with brash.

**Note Liaise with Establishment team as to which temporary water crossings are to be retained to facilitate full access to the site for their operations.**

***Water Crossings – Additional Guidance***

- *Do NOT cross directly over the stream bed of any type of watercourse.*
- *Avoid crossing points in hollows where there is a risk of surface water that may lead to sediment release.*
- *Where a drain crossing is needed, select a method that prevents the breakdown and erosion of drain sides.*
- *Where necessary, use plastic piping of suitable size to fit the drain and cover with brash material.*
- *When removing the temporary crossings, extreme care must be taken to carefully peel back the brash and to lift the poles individually to the bank side.*
- *Avoid dragging the poles through the watercourse causing damage to the bank side and to avoid dislodging collected sediment.*
- 
- *Larger Relevant Watercourses and deep drains should be protected similar to Aquatic Zones.*
- *Where practical and available, consider using a prefabricated drop-in bridge.*

**Silt Control**

42 Install silt traps close to potential sources of silt runoff.

43 Monitor silt traps and install additional traps if necessary.

44 Place material taken from silt traps as far away as possible from waterflow.

45 Ensure that all silt traps are fully functional before removing machinery from site.

Figure 15. A functioning silt trap on a harvesting site that is vegetating over.

**Table 6.3**, continued

**Weather**

50/51 Suspend forwarding during periods of heavy rainfall or move Operations to a less sensitive part of site.

***Weather – Additional Guidance***

- *Ensure that the most sensitive areas of the site take priority during dry weather.*
- *Select the most appropriate time to conduct forest operations to suit site conditions, noting that winter harvesting has the shortest days, the most precipitation and poorest drying conditions.*

**Monitoring**

53 Daily visual water monitoring is required on all sites rated BLUE or RED for Water/Soils, and on GREEN sites where deemed necessary by Coillte FWM/PSCS.

***Monitoring – Additional Guidance***

- *In the event of a significant rainfall event, record the stopping of operations and/or the movement of machines to a drier part of the operations site.*

**Pollution Control & Emergency Response**

55 Implement pollution control procedures in the event of siltation of water, oil or chemical spill and report to manager.

***Extraction Routes and Hotspots – Additional Guidance***

- *Plan for timber extraction rack layout, pinch points/hot spots and turning areas do not become a source of sediment runoff to aquatic zones. Note, based on a site assessment, for 2nd and subsequent thinnings it may be necessary to avoid using existing main extraction racks.*
- *Avoid extraction routes in the base of valleys where possible.*

### TABLE 6.4 ERA SITE-SPECIFIC MITIGATIONS – HARVESTING GUIDANCE FOR SILT & SEDIMENT CONTROL

The following table presents the SITE-SPECIFIC Mitigations that refer to silt & sediment control and provides additional guidance to silt control measures particularly relating to water crossings, silt control, extraction routes and hotspots.

**Water Crossings**

26 Specify location and number of Water Crossings on Aquatic Zones & relevant watercourses.

***Water Crossings – Additional Guidance***

- *On sensitive sites consider the use of a temporary crossing made of poles, covered with geotextile and brash.*
- *Mobile prefabricated temporary bridges should be considered, where and when available, to bridge sensitive waters.*

Figure 16. Temporary bridge.

Figure 17. Mobile prefabricated bridge used as a temporary crossing over sensitive aquatic zone.

**Table 6.4**, continued

**Silt Control**

| | |
|---|---|
| 27 | Specify the number & locations of silt traps (mandatory on blue & red water sites). |
| 28 | Monitor and upgrade existing silt traps during operations, if necessary. |
| 29 | Decommission the silt traps that are no longer required. |
| 30 | Specify post operational maintenance plan (following completion of the operations the condition of watercourses & silt traps should be assessed & a post operation maintenance plan drawn up). |

***Silt Control – Additional Guidance***

- *At pinch points in the vicinity to the aquatic zone, where there is a risk of silt laden surface water flow, deploy silt curtains to slow the water and retain the sediment on site.*
- *Silt traps should be located close to the source of silt as possible.*
- *Silt traps should be staggered in a series along the length of the relevant watercourse/drain.*

Figure 18. Silt curtain used to contain surface water siltation.

Figure 19. Silt traps placed in series in a roadside drain

***Slope***

- *Stipulate in the ERA what maximum slope is tolerable for harvesting machinery (wheels from the harvesting machinery may cause rutting and be a cause of silt run-off); see slope categories below:*

| **Slope category*** | **Slope** | **Risk** |
|---|---|---|
| Moderate (**M**) | Even to 1 in 7 (<15%) | Low |
| Steep (**S**) | 1 in 7 to 1 in 3 (15-30%) | Moderate |
| Very steep (**VS**) | 1 in 3 or greater (>30%) | High |

**Source: DAFM*

***Aquatic zones and relevant watercourses***

- *The layout of the extraction racks should minimise water crossing and avoid machine movements in exclusion zones.*

***Soil type***

- *In certain soil types, such as gley, peaty gley and peat soils have high erodibility potential, this should be taken into consideration when the planning the silt control mitigations.*

***Extraction Routes and Hotspots – Additional Guidance***

- *No continuous harvesting operation is permitted without a brash mat in place as unbrashed racks causes significant siltation.*
- *To avoid surface water siltation, keep brash mats in a good state and utilise fresh brash for replenishing main extraction routes and stacking areas.*
- *Use pulp/stake lengths in the brash mats where brash availability is poor.*
- *Employ longer than standard tree tops used in a brash mat, laying it out at right angles to the direction of travel of the harvester, in order to increase the load bearing capacity of the mat and reduce the risk of sediment mobilisation.*
- *Avoid traversing hotspots.*
- *In windblown sites, great care should be taken in the removal of timber and avoid trafficking over the hotspot under the fallen timber.*
- *Remediation drainage may be required to divert and slow water from reaching the aquatic zone.*

### TABLE 6.5 ERA STANDARD MITIGATIONS – ESTABLISHMENT GUIDANCE FOR SILT & SEDIMENT CONTROL

The following table presents the Standard Mitigations that refer to silt & sediment control and provides additional guidance on some of these, i.e. Mitigation No's 61-66 and 68.

**Aquatic Zones & Relevant Watercourses**

49 Do not install silt traps on or within the setback of an aquatic zone.

**Setbacks**

51 No machinery operations to take place in the setback unless unavoidable and justified and specified in the ERA in the site pack.
53 Do not cultivate within the setback.
54 Where planting within setback is specified in the ERA, pit plant only.

**Water Crossings**

56 Where aquatic zones or watercourses have to be crossed a temporary bridge must be constructed by placing logs at right angle to flow of water or insert plastic pipe.

**Note At Harvest Block verification meetings, agree with Harvesting team as to which temporary water crossings are to be retained to facilitate full access to the site for operations.**

**Silt Control**

57 Install silt traps close to potential sources of silt runoff.
58 Monitor silt traps and install additional traps if necessary.
59 Place material taken from silt traps as far away as possible from water flow.
60 Ensure that all silt traps are fully functional before removing machinery from site.

***Silt Control – Additional Guidance***

- *Where possible redirect water towards a vegetated and unplanted soakaway area that will 'slow the flow' of water and capture sediment.*

**Drainage**

61 Do not disturb existing drains within the setback zone.
62 Ensure all cut off drains taper out before entering the setback.
63 Align drains as close as possible to the contour line to slow the water movement.
64 Use rock armour, if available, to control water flow in new drains.
65 Install drop downs in new drains to control water flow.
66 Stagger drainage to slow water movement and dissipate water over vegetated unplanted areas.

***Drainage – Additional Guidance***

- *Ensure that the layout of the drains is such that it can manage the volume of surface water flow on site.*
- *Plan for extreme weather events and minimises potential erosion problems on site.*

**Table 6.5, continued**

**Weather & Timing**

68 Suspend operations during periods of heavy rainfall or move Operations to a less sensitive part of site.

***Additional Guidance - Weather***

- *Ensure that the most sensitive areas of the site take priority during dry weather.*
- *Select the most appropriate time to conduct forest operations to suit site conditions, noting that winter harvesting has the shortest days, the most precipitation and poorest drying conditions.*

**Monitoring**

70 Daily visual water monitoring is required on all sites rated BLUE or RED for Water/Soils, and on GREEN sites where deemed necessary by Coillte Forest Works Manager.

### TABLE 6.6 ERA SITE-SPECIFIC MITIGATIONS – ESTABLISHMENT GUIDANCE FOR SILT & SEDIMENT CONTROL

The following table presents the SITE-SPECIFIC Mitigations that refer to silt & sediment control and provides additional guidance on mitigations 29-32, drainage, slope and soil type and cultivation.

**Setbacks**

19 Leave setback zone to vegetate naturally.
20 Plant small groups of broadleaves.
21 No mounding to take place within 30m of the aquatic zone.
22 Mound drains to end 50m back from aquatic zone.

**Water Crossings**

28 Specify location and number of Water Crossings on Aquatic Zones & relevant watercourses.

**Silt Control**

29 Specify the number & locations of silt traps (mandatory on blue & red water sites).
30 Upgrade existing silt traps.
31 Decommission the silt traps that are no longer required.
32 Specify post operational maintenance plan (following completion of the operations the condition of watercourses & silt traps should be assessed & a post operation maintenance plan drawn up).

***Silt Control – Additional Guidance***

- *Utilise existing drain network within the site by installing a mechanical sediment trap (dug out hole in the drain channel using an excavator and lining it with stones).*
- *Note the direction of water flow, install a geotextile silt trap downstream of the mechanical sediment trap.*
- *Alternatively, install sump holes within the drain with filtration overland.*
- *Install cut offs along the primary extraction route to divert water overland.*
- *Dissipate water from field drains overland.*

Figure 20. A geotextile silt trap that is being vegetated over.

**Hotspots**

33 Do not carry out ground cultivation or drainage on hotspots.

**Weather**

34 Restrict operations to dry periods of the year.

**Table 6.6, continued**

***Drainage– Additional Guidance***

- *Block Legacy drains where noted to be carrying water directly to aquatic zones.*

***Slope and soil type***

- *Care is required when planning drainage layout and sediment control measures on steeper slopes with erodable soils due to the potential for increased water velocity and the heightened risk of erosion and runoff, and subsequent sedimentation of receiving watercourses.*
- *Legacy mound and field drains may become reactivated in extreme weather events and the higher water table following the removal of the forest cover.*

| Soil Type | <3° 1-in20 | 3° - 6° 1– in-20 to 1– in-10 | 6° - 8° 1– in-10 to 1– in-7 | 8° - 17° 1– in-7 to 1– in-3 | 17° - 30° 1– in-3 to 1– in-2 | >30 >1– in-2 |
|---|---|---|---|---|---|---|
| Erodible eg. brown earths & gleys | L | L | M | H | H | H |
| Very erodible eg. podsols and some peats | M | H | H | H | H | H |

*Table: Risk rating for soil erodability, based on soil type and slope ('L' = low risk; 'M' = medium risk; 'H' = high risk). Source (DAFM amended)*

***Cultivation – Additional Guidance***

- *When carrying out an ERA of the site, determine what is the most appropriate cultivation method, note in some portions of the site 'no cultivation' may be required. Cognisance of both the slope and soil type should be included. The following options should be considered:*
  - *Windrowing and mounding.*
  - *Windrow only.*
  - *Pit plant only.*
  - *Increased setbacks on steep or sensitive sites.*
- *Small coupe planting of appropriate broadleaves in the setback.*

## APPENDIX I - ALL FOREST OPERATIONS - SILT MITIGATIONS

### 1.1. Glossary

| Feature | Definition & Identification |
|---|---|
| **Aquatic zone (AZ)** | Any natural river, stream or lake (but not an artificial drain) illustrated on an Ordnance Survey 6-inch map. These are typically indicated by a directional arrow along their length.<br><br>(Note: The EPA water layer is a subset of aquatic zones onsite). |
| **Relevant watercourse (RW)** | Any other watercourse that has the potential to act as a pathway for the movement of sediment and/or nutrients from the site to an aquatic zone.<br>Relevant watercourses are often artificial. They include existing drains & channels and other potential pathways that may contain flowing water during & immediately after rainfall.<br>Note, not every watercourse may be a 'relevant watercourse'. For example, a well-vegetated agricultural drain on moderately sloping ground may not be a relevant watercourse.<br>Cross reference with the OSI 1:25", OSI_5000 and Prime 2 layers to assist in identifying relevant watercourses. NOTE **Prime 2** must be ground truthed as it may indicate other environmental features (paths, ditches etc.) other than watercourses. |
| **Drains** | Former agricultural furrow drain or mound drain that retains water and doesn't have the potential to carry significant amounts of sediment/nutrients off site. Roadside drain which doesn't have connectivity with an AZ. |
| **Hotspots** | An area (often localised) that is a potential source for sediment / nutrient loss during afforestation/ reforestation. Examples include soft wet ground, flushes and springs, and pockets where machine access is difficult due to low ground-bearing capacity, small groups of windblown trees or complex drainage channels resulting in a lot of surface water runoff. |
| **Water abstraction point** | Abstraction point of any surface waters, borehole, spring or well used for the<br>abstraction of water for human consumption in a water scheme. |
| **Exclusion zone** | Minimum distance from the edge of all AZs, hotspots and water abstraction points, where machinery **should not** traverse unless agreed with the FWP in advance and recorded in the site monitoring form. |
| **Setback** | A water setback is a (largely) unplanted and undisturbed open space of a defined width installed |

| | |
|---|---|
| | to protect a particular watercourse / archaeology / public road / landscape / building / environmental feature. |

## APPENDIX II - ALL FOREST OPERATIONS - SILT MITIGATIONS

### 1.1. Construction of Silt Traps

**Definition:** A silt trap is a method of preventing silt from entering an aquatic zone. It is designed to slow the flow of water in a drain or relevant watercourse leading to the settling out of the suspended silt to form a sediment at the base of the trap. The silt traps can be installed singly but are more effective if 2 to 3 silt traps are placed in series some 10 m apart.

### 1.2. Recommended Materials

- 1 – 3 timber (non-creosote) posts (per silt trap): 1 to 1.2 m long x 5 to 10 cm diameter.
- 1 roll of non-woven geotextile*.
- Wire fasteners, cable ties, staples or tacks.

### 1.3. Specification and source of geotextile*

This is somewhat of a judgement call based on availability, site conditions, such as slope and soil type, and the range of silt mitigations to be implemented. Nevertheless, it is recommended that the larger pore and permeability non-woven geotextile, such as Thrace NW Standard (90NW) or Bontec NW7 would be suited for a 'permeable' silt trap, while the 'barrier' silt trap (such as PB2000 Thrace Synthetic (S16NW) or Terram T1000 (T1000)) would be more appropriately be used in a silt curtain to mitigate silt laden overland flow.

| Product | Non-woven | Size of pores um | Peramability (l/m2S) | Tensile Strength (kN/m) |
|---|---|---|---|---|
| **PB2000 Thrace Synthetic (S16NW)** | Non-woven | 80 | 90 | 16 |
| **PB1000 Thrace Synthetic (S8NW)** | Non-woven | 100 | 130 | 8 |

| | | | | |
|---|---|---|---|---|
| **Thrace NW Standard (90NW)** | Non-woven | 114 | 137 | 7 |
| **Terram T1000 (T1000)** | Non-woven | 90 | 90 | 8 |
| **Bontec NW9** | Non-woven | 115 | 108 | 9 |
| **Bontec NW7** | Non-woven | 135 | 115 | 7 |

### 1.4. Source of geotextile and other materials

They can be purchased in nationwide stores such as Chadwicks, Cork Builder Providers, Brookes and other large hardware /farm co-op providers who can supply UV stablised **non-woven geotextile** produced from 100% polypropylene staple fibres that matches the above specifications.

### 1.5 Silt trap location

- ✓ Care should be taken in the location of the silt traps. They should be installed **on forest drains or relevant watercourses only**.
- ✓ Target shallow forest drains that discharge into relevant watercourses and/or aquatic zones and don't have strong water flow even after a heavy rainfall event.
- ✓ Select a point on the watercourse where it naturally narrows in a 'pinch point' and install the silt trap.
- ✓ Silt traps should be staggered along the length of the drain, focusing where silt loss is originating on site.
- χ Do not install silt traps in large drains that has strong water flow.
- χ Do not install silt traps in exclusion zones or setbacks.

### 1.6 Silt trap construction

**Silt Trap - Type A**

- Drive the post into the ground, flush with the bankside, on each side of the forest drain (or relevant watercourse), to a depth of at least 30cm.
- Cut to fit and insert a 3rd post above the level of waterflow across the watercourse and secure to the two original posts.
- Cut sufficient non-woven geotextile to cover the span of the poles, ensuring enough excess to allow for folding and overlapping around the posts. Remove excess membrane at the end of the installation.
- Secure the geotextile to the poles using staples or sections of small wooden lats with nails driven through.
- Using a spade, cut a narrow slit across the bed of the watercourse to tuck the membrane into it with the spade.
- Insert a notch into the geotextile under the cross pole.
- Ensure that no water is allowed to flow under the geotextile and visible leaks should be sealed.
- Further secure the ground edges of the geotextile with large stones and the side edges with wooden stakes.

Figure 21. Newly installed functioning silt trap suitable for site with impenetrable substrate.

**Silt Trap - Type B**

- Stand the timber posts in a '∧' formation. The lead post of the '∧' should be in the middle of the channel. The two end support posts should be set behind the lead post approx. the same distance as the width.
- Drive the three posts into the ground approx. 40cm or until completely stable. Note, if the distance between two posts is greater than 1 m, additional posts may be required.
- Cut the required length of geotextile material to span the '∧' with enough excess to wrap around the support posts – approx. 40 cm.
- Secure the geotextile to the posts.
- Using a spade, cut a narrow slit across the bed of the watercourse to tuck the membrane into it with the spade. Commercially available anchor pins or clean gravel / cobble may also be used.
- Ensure there are no gaps that allow silt laden water to escape.

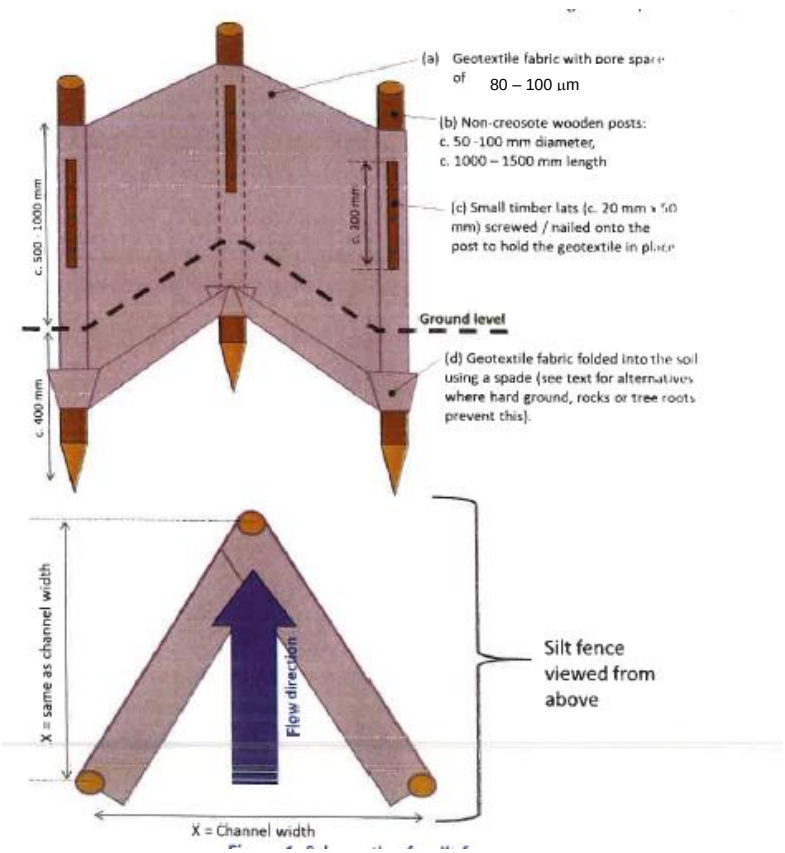


Figure 22. Silt trap design B.

## 1.8 Silt curtains

- Silt curtains are an effective way to stop silt laden surface water flow running into adjacent watercourses.
- 
- They form a physical barrier, capturing the water and enabling it to seep into the ground.
- Silt curtains are ideally located at the perimeter of hotspots or adjacent to relevant watercourses or aquatic zones.
- It is constructed similar to a silt trap, ensuring that the geotextile is tucked into the ground with a spade to avoid water running underneath it.
- Dig the base of the silt curtain into the soil using an excavated trench (10–15 cm deep) to prevent bypass flow underneath.
- Where possible, use a continuous roll of geotextile material to avoid joints.
- Support barriers with regular timber posts of minimum 7.5cm diameter.
- The geotextile used should be either the PB2000 Thrace Synthetic (S16NW) or Terram T1000 (T1000)), where possible.

Figure 23. Silt curtain where the protected hotspot is vegetating over.

## 1.9 Mechanical sediment traps

- During forest establishment and engineering works, mechanical sediment traps have proved to be very effective in capturing and retaining water borne sediment.
- They are normally located in forest drains and installed with an excavator. The dug hole should be lined with clean stones, when & where possible.
- Depending on the forest drain, the mechanical sediment traps should be installed in series, approximately 10-15 m apart and the last trap prior to flowing into a relevant water course or aquatic zone should be bounded with a silt trap.

Figure 24. A functioning mechanical sediment trap with an adjacent silt trap.

### 1.10 Log / Leaky dams

- Best done during harvesting operations as suitable machines are available to cut the logs and insert them in the drains.
- Suitable for drains /relevant watercourses that have a peat or silt (sediment) substrate (not subsoil, gravel or stones) and have a low gradient where the dam is unlikely to wash out of position in high flows.
- Select pole lengths 0.5-1.0m long, stacked on top of each other, above the high-water mark and parallel to water flow direction. Ensure they are securely in place as indicted in the adjoining figure.
- Leaky / log dams (x 3) should be laid out in a series in the drain.
- Leaky dams are **NOT** to be used as crossing points.

Figure 25 – Log / leaky dam located in a roadside drain, this will 'green up' or vegetate.

### 1.11 Monitoring

Check the silt mitigations regularly and maintain as necessary, to ensure continued effectiveness both during and after operations.
In the event that you need to remove a damaged silt trap, a new silt trap should be in place first downflow of that to be removed.

### 1.12 Removal

Silt mitigation measures are generally temporary measures. Surrounding vegetation will colonise and stablise the retained silt enabling it to be removed. However, in certain instances, this could dislodge the retained sediment, in which case it may be best to leave the silt trap in place, to eventually become covered by vegetation.

**APPENDIX III – ENGINEERING - INSTALLATION OF CULVERTS (SAMPLE METHOD STATEMENTS)**

### 2.1 Roads - Crossing of Relevant Water Course / Aquatic Zone Crossing of Relevant Water Course / Aquatic Zone - Over Pump

In this instance, the culvert will be installed using a bund and water pump. The following steps will be taken during the installation:

- If water is flowing in the watercourse, a temporary bund will be placed on the upstream side of the new crossing using local material to stop the flow of water.
- A large pump will be used to pump the water from behind the bund, past the works area and back into the downstream side of the works.
- The existing channel will be cleared and levelled with 3-inch clean material.
- The culvert will be sunk to allow 1/3 of the pipe to be full of water at normal flow levels.
- The culvert will be installed on a bed and surround of 75mm down crushed stone.
- The channel will be back filled with purchased crushed stone.
- Once the culvert is installed, the road will be constructed over the culvert.
- The pump will be turned off and the bund will be removed once all water is running in the new culvert and the road is constructed.

**Crossing of Relevant Water Course / Aquatic Zone - Install at low flow**
In this instance, the culvert will be installed during a period of low flow. The following steps will be taken during the installation:

- If water is flowing in the watercourse, a geotextile-based silt trap will be placed on the downstream side of the new crossing.
- The existing channel will be cleared and levelled with 3-inch clean material.
- The pipe will be sunk to allow 1/3 of the pipe to be full of water at normal flow levels.
- The culvert will be installed on a bed and surround of 75mm down crushed stone.
- The channel will be back filled with purchased crushed stone.
- Once the culvert is installed, the road will be constructed over the culvert.
- The silt trap will be left in situ until such time as it can be cleaned and removed.

**Crossing of Relevant Water Course / Aquatic Zone - Block and Overland Filtration**
In this instance, the culvert will be installed by using a bund to divert water onto the forest floor temporarily why the culvert is installed. The following steps will be taken during the installation:

- If water is flowing in the watercourse, a temporary bund will be placed on the upstream side of the new crossing using local material to stop the flow of water.
- The bund will be placed in such a way as to divert the water to the opposite side of the working area. A temporary channel may need to be constructed to ensure the water gets away from the work zone.
- The existing channel will be cleared and levelled with 3-inch clean material.
- The culvert will be sunk to allow 1/3 of the pipe to be full of water at normal flow levels.
- The culvert will be installed on a bed and surround of 75mm down crushed stone.
- The channel will be back filled with purchased crushed stone.
- Once the culvert is installed, the road will be constructed over the culvert.
- The bund will be removed once all water is running in the new culvert and the road constructed.

**APPENDIX IV – ENGINEERING - CULVERT SPACING**

### 3.1 Culvert Spacing

The spacing of culverts depends mainly on the gradient of the road, the amount of rainfall, the steepness of the terrain and the soil conditions. In a watershed forest in steep terrain with high rainfall, the proposed spacing (in metres) of culverts is derived from 800 ÷ Percentage Gradient. However, in areas with heavy rainfall and large catchment areas, a shorter spacing may be required, especially on roads with a 9% (1 in 11) gradient or steeper. The correct spacing of culverts may however be worked out through experience.

The table below should serve as a guideline.

| Road Gradient in Percent | 800 / Gradient (metres) | Suggested spacing in steep terrain with heavy rainfall (metres) |
|---|---|---|
| 5 | 160 | 80 |
| 6 | 130 | 65 |
| 7 | 114 | 55 |
| 8 | 100 | 45 |
| 9 | 88 | 40 |
| 10 | 80 | 35 |
| 11 | 72 | 30 |
| 12 | 66 | 20 - 30 |

**APPENDIX V– ENGINEERING - ESTIMATION OF WATERWAY AREAS**

## 4.1 ESTIMATION OF WATERWAY AREAS

In order to ensure that an appropriately sized culvert structure is constructed, the required waterway area must be estimated. This section is intended to give guidance on this procedure but as stated previously, all design and construction work for crossing structures exceeding 1.2 square metres waterway area, must be carried out by competent designers and contractors

The maximum discharge of a given stream will depend on -

- Catchment area (i.e. land area contributing to the stream);
- Rainfall intensity and duration; and
- The time of concentration for the catchment (which depends on the nature of the area's surface conditions and slope and is a function of what is usually called the Run-off Factor). Flat heavily vegetated areas will tend to have long times of concentration especially if the soil is permeable and not already saturated. These areas will require rainfall of long duration or high frequency to reach maximum discharge in outfall streams. Steep bare impermeable catchments will have very low times of concentration and outfall streams will be subject to flash floods during high rainfall intensity of quite moderate duration.
- The methods of estimating probable waterway area required are –
    - Where a well-defined channel exists reasonably close to the culvert or bridge location evidence of previous flood flows may be present and the cross-sectional area at that level can be measured.
    - Old culverts on the same stream will yield valuable evidence.
- There are several theoretical methods of varying complexity. The Talbot formula, which is one of the simplest to use, gives a reasonable degree of accuracy when catchment areas (less than 2000 ha) are carefully measured and the appropriate value is given to the co-efficient.
- This formula is - $A = 0.184\ C\ (M)\ 0.75$
  Where A = Waterway Area ($m^2$)
  M = Catchment Area (ha)
  C = A co-efficient varying from 0.125 (flat retentive sites) to 0.5 (steep impermeable areas)
  The values C = 0.125 and 0.25 suit the majority of sites.
  For convenience, this formula is given in chart form on the next page.
  The use of both direct measurement and theoretical methods of computation for the given situation is recommended as a double check. When the waterway is calculated the appropriate size culvert or bridge opening can be selected.

## E.7. ESTIMATION OF WATERWAY AREAS USING THE TALBOT FORMULA

$$A = 0.184\ C\ (M)^{0.75}$$

Where A = Waterway Area (m²)
M = Catchment Area (ha)
C = A co-efficient varying from ⅛ (flat retentive sites) to ½ (steep impermeable areas)

| Catchment (ha) | Waterway Area (sq. meters) | | |
|---|---|---|---|
| | c = 0.125 | C = 0.25 | c = 0.5 |
| 5 | 0.077 | 0.154 | 0.308 |
| 10 | 0.129 | 0.259 | 0.517 |
| 20 | 0.218 | 0.435 | 0.870 |
| 50 | 0.432 | 0.865 | 1.730 |
| 100 | 0.727 | 1.455 | 2.909 |
| 150 | 0.986 | 1.972 | 3.943 |
| 200 | 1.223 | 2.446 | 4.893 |
| 250 | 1.446 | 2.892 | 5.784 |
| 300 | 1.658 | 3.316 | 6.632 |
| 400 | 2.057 | 4.114 | 8.229 |
| 500 | 2.432 | 4.864 | 9.728 |
| 600 | 2.788 | 5.577 | 11.153 |
| 700 | 3.130 | 6.260 | 12.520 |
| 800 | 3.460 | 6.920 | 13.839 |
| 900 | 3.779 | 7.559 | 15.117 |
| 1000 | 4.090 | 8.180 | 16.360 |
| 1200 | 4.689 | 9.379 | 18.757 |
| 1400 | 5.264 | 10.528 | 21.056 |
| 1600 | 5.819 | 11.637 | 23.274 |
| 1800 | 6.356 | 12.712 | 25.424 |
| 2000 | 6.879 | 13.757 | 27.514 |