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FURTHER INFORMATION

The Silkwood Drainage Board Grower Group (SDBGG) Final Report (2010) is available from the SDB office at Terrain NRM in Innisfail or the SRDC web site for any further information. The project report details how the sediment traps were designed, constructed and monitored. The SDB sediment trap project has only established the field data utilized in this field booklet from the SDB wet tropics area. It is not intended to be representative of any other area. Please read the disclaimer on page two of this booklet as this guide is limited in its application. Industry references have been made and noted as a source of current supporting information.

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SILKWOOD DRAINAGE BOARD

SEDIMENT TRAPPING FIELD GUIDE

IDEAS TOWARDS SUSTAINABLE FARM DRAINAGE SYSTEMS

A SILKWOOD DRAINAGE BOARD GROWER GROUP PROJECT

- **Identifying the need and benefits of sediment traps**
- **Wet tropics field tested sediment trap designs**
- **Design data on sediment trap performance**
- **Photos of retro fitted operational sediment traps**

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Disclaimer:

The Silkwood Drainage Board are in no way promoting the adoption of the practices highlighted in this booklet. You should consider your particular situation and climatic conditions before making changes based on the results presented here. The field data analysed in this booklet is particular for the Silkwood Drainage Board Wet Tropics Area and is not intended to be representative of other areas.

FIELD DATA SHOWING AN ESTIMATION OF SEDIMENT RETENTION AT ONE 35 HECTARE SITE USING POST & JAKEMAN (1995) FORMULA STATING THAT: SEDIMENT LOAD KG./CU. MT. = [1.47*NTU VALUE+1.917/1000*CU. MT. WATER FLOW]

Date	Rainfall over 24 hours (South Johnstone station)	Drain flow cubic metres over 24 hours	Reduction in NTU value	Reduction in sediment load over 24 hours (estimated)
08/05/09	19 mm	3,325 cu mt	35	177 kg
11/05/09	107 mm	18,725 cu mt	10	311 kg
26/05/09	26 mm	4,550 cu mt	8	62 kg
12/11/09	58 mm	10,150 cu mt	25	392 kg
11/03/10	47 mm	8,225 cu mt	3	52 kg
17/03/10	12 mm	2,100 cu mt	10	35 kg

REVEGETATE THE TRAP SITE (CONTRIBUTED BOB STEWART)

Vegetation of appropriate species around sediment traps is desirable. Bottle brush has an intense root system which stabilizes banks well (common along the banks of the Johnstone River). Bottle brush shrubs could be planted in two rows around the edges of the traps leaving a convenient access point for cleaning out. Bottle brush can also be planted in the rock weirs in order to stabilize them where they are subject to strong flows. However, doing this removes the option of lifting and resetting the rock weirs when they become clogged with sediment and cease to be leaky. Other species that could be appropriate for a farm situation would be Lilly-Pilli shrubs. If there is no problem with tall trees then you could also plant River Cherries and Golden Pendar and if you are close to brackish water, Cottonwood.

A NOTE OF CAUTION

Please note that the ability to accurately determine sediment loading from NTU values is limited. According to John Dowding (2008) he suggests that the formula which maps correlation between NTU values and sediment loads can not be just blanket applied to any chosen environment due to the large variations which occur in soil particle size and colorings. Suspended organic matter can also affect NTU readings. It can however be used as a guide to help in the design of sediment traps.

SUMP TRAPS

Sumps are a flexible tool which can provide an opportunity for heavy bottom flowing sediment to get caught and collected in. This picture shows how a sump is formed by slightly widening and deepening the drain. This is particularly effective if it is fitted just prior to where small drains flow directly into streams.

IMPORTANT POINTS FOR SEDIMENT TRAP DESIGN

The flow of water through a trap is directly related to its point of entry into the trap. It was observed (in particular with the square design) when the entry water flow went to a corner of the trap, the flow through the trap followed the perimeter of the trap to the discharge point. This meant that the volume of the trap was not being fully utilized as the central water volume tended to remain static.

SEDIMENT TRAP MAINTAINANCE

As sediment and thrash build up over time through the rock wall, it will be necessary to disturb and reposition the rock weir every couple of years to ensure that water is freely flowing through the wall. When the trap becomes dry it should be inspected for sediment build up to determine if it is necessary to clean it out. This photo shows sediment as the grey/ brown layer sitting on the orange base clay. This is from one wet season.

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IDEAS TOWARDS BEST PRACTICE

The wet tropics coast of Far North Queensland presents particular problems for sugar cane farmers. Apart from the seasonal cyclones which cause widespread flooding, the monsoon rain season places heavy demands on the farm drainage systems. This SDBGG project has recognized the importance of these drainage systems working in an efficient and environmentally sustainable way. This has been pursued as the key outcome for the project.

It is recognized that cultivated land is the most likely source of farm sediment runoff. It is important that farmers limit sediment load in this runoff. Green cane harvesting has contributed greatly to this end. However, the planting of new cane, which occurs approximately every six years, will require the cultivation of farm paddocks well into the future. This is especially so when paddocks are laser leveled and/or row spacing are changed, such as changing over to dual row farming. Therefore, farmers need to ensure systems are in place to limit off-farm sediment runoff from these cultivated areas.

This project has developed a system of farm sediment traps and sumps which have been retro fitted to farm drains in the Silkwood Drainage Board area to help control sediment load which has made its way into the drainage systems.

DESIGN DATA FOR SEDIMENT TRAP PERFORMANCE

The reference table here shows the approximate size of the sediment trap required to hold water for either 10 or 20 minutes from the different size paddock catchments. This is based on rainfall at 10 millimetres per hour and a runoff coefficient of 0.5 (50%). Please note that very sandy soils will have a lower runoff and very clay type soils will have a higher runoff. The holding time that can be achieved for drain water in the trap is dependent on factors such as; 1. the size of the trap (the primary factor), 2. the speed of water flow through the trap (this is dependent on the fall in the drain and the water volume from rainfall), 3. the design of the trap (water flow can be slowed by forcing it to change direction and restricting it at the rock weir). Farmers need to evaluate their own situation to establish what trap holding time they will aim for- given the cost of trap construction and the drain space available. Bare in mind that traps could be enlarged at a latter date to improve effectiveness. The table below uses the Post & Jakeman (1995) formula to establish an approximate co relationship between NTU value and sediment load. This table highlights possible reductions in sediment load.

Catchment area of paddock (hectares)	Trap holding time in minutes	Trap size required in cubic metres
10 ha	10 mins	83 cu mt
	20 mins	167 cu mt
20 ha	10 mins	167 cu mt
	20 mins	333 cu mt

Reduced turbidity as a NTU value between entry & exit points of the sediment trap	Volume of water in cubic metres per hour from 30 hectares at 10mm rain/hr at 0.5 coefficient	Volume of sediment reduction in kilograms per hour using Post & Jakeman formula	Volume of sediment reduction in kilograms per 24 hour period
5 NTU	1500 cu/mt	14 kg	336 kg
10 NTU	1500 cu/mt	25 kg	600 kg
15 NTU	1500 cu/mt	36 kg	864 kg
20 NTU	1500 cu/mt	47 kg	1128 kg

CONSTRUCTION MATERIALS

Quarry rock in a minimum size of 300 mm is used to control the outflow from a sediment trap. It is placed at the exit point, on the drain floor, to act as a 'leaky' weir. The height you choose to set the stone at is particular to each sediment trap site; considering water flow, the fall of the drain floor and how much restriction may occur in the drain system. Rock will cost approx $25/tonne A trap will need around five tonne to create a leaky weir.

METHODS OF CONSTRUCTION

A long reach excavator is the ideal machine to construct a sediment trap. If the drain is wet at the time it will be best to stockpile the fill on site until it dries. Once dry, it can be shifted to where it is best utilized. Excavators can cost between $120 to $140 per hour to hire and it will take a full day to dig a trap. The cost of truck hire to remove the fill should also be considered. When excavation is completed the rock weir can be placed into position at the exit point with a backhoe.

MONITOR THE SEDIMENT TRAP

The simplest method to measure trap efficiency is to install rising stage sample pots at both the entrance and the exit point of the sediment trap. These can be either single or multi stage samplers. The cost is approx $100 each and a simple PVC holder can be made on a star picket. The collected water can be tested with a turbidity tube (a clear tube with NTU value numbering which gives the test water a visual reading of turbidity). The NTU value for the entry and exit points of the trap can be compared to record the difference. Sediment capture can then be approximated by using the table page 9.

GENERAL OBSERVATIONS

Sediment traps are designed to capture dissolved sediment on a rising stage of flow or increasing sediment load, which is generally the result from heavy rain impacting on exposed ground. Once the flow has peaked and sediment load is falling, sediment capture is less. Plant cane blocks in particular have much higher sediment runoff (higher Nephelometric Turbidity Units) as compared to ratoon cane which has been green cane harvested with nil to minimum tillage.

It has been observed that when testing drain water by a turbidity tube, if the Nephelometric Turbidity Units (NTU) value is less than 25, the remaining solids tend to be more highly dissolved and unlikely to fall out of suspension between the entry and exit point of a sediment trap. Whereas when readings are over 40 NTU and there is noticeable/visible sediment in temporary solution or suspension, differences are found in NTU values between entry and exit points. Sump traps or smaller sediment trap structures are more suited for course sediment capture, which is the bottom flowing or poorly suspended sediment. These are especially useful where smaller farm drains flow directly into the local stream.

INSPECT FARM DRAINS

Inspection is best carried out directly after heavy rain, as this will ensure all drain lines are flowing well. It is important to note what is working well and what parts are not as these factors can affect how a sediment trap may work. It may be necessary to rectify these problems first. During inspection note which areas of the farm are more inclined to have sediment runoff.

SURVEY THE TRAP SITE

The main factors affecting the positioning of a sediment trap are; 1. the stability of the soil (sandy or granite type soils can be problematic during/after drain excavation); 2. the amount of free space or headland available (how will placement of the trap affect farming operations); 3. what is the estimated cost and 4. what effect will the trap have on paddock drainage. It is best to site the trap in a flat section of drain.

CALCULATE CATCHMENT AREA AND WATER FLOW

The area of paddock catchment affects the size of trap required. On an catchment area of 30 hectares, a rainfall rate of 10 millimeters per hour and a runoff coefficient of 0.5 (50%), this equates to approximately 1500 cubic metres of rainfall runoff per hour. Using a settling time of 20 minutes as an ideal to aim for, the trap size would need to be excavated out to 500 cubic metres (25 mts long*10mts wide*2mts deep).

IDENTIFY THE BENIFITS

The main benefit is the environmental sustainability of the farm. When land is cultivated it becomes subject to water erosion which could become sediment runoff into the farm drainage system. The course sediment can be managed by utilizing a sediment trap within the drain system. This may capture some sediment before it moves into the main creeks. Captured sediment can then be returned to the paddock by a backhoe and truck.

SEDIMENT TRAP DESIGN

This project has utilized two designs; the drain widened rectangular type and the square design trap. Trap design will generally depend on the geographical factors particular to each trap site. The proposed trap needs to ‘fit’ the existing drain without detracting from the drains performance and/or encroaching too much on headland space. The depth of the trap will depend on the stability of the drain walls.

The purpose of the trap is to hold runoff water for 20 minutes to allow sediment to drop out of suspension. The effectiveness of the sediment trap is derived from its size rather than its shape although a ‘S’ bend design trap at two metres deep can be effective in capturing sand sediment (useful on a sloping drain line). Trap design should have water flow entering the centre of the trap as this allows better utilization of the whole trap volume whereas a side entry point can result in water moving around the perimeter.