



## Welded Mesh Gabions and Mattresses River Protection Design Guide

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# INTRODUCTION

Gabion mattresses are large plan area gabion units in depths generally of 0.15, 0.225, 0.3 and 0.5m.

Each unit as standard is sub divided into cells normally not exceeding 2m x 1m.

The purpose of a gabion mattress is to protect river beds, river embankments and coastal embankments against erosion. Other uses include reveting of steep slopes and outfall and inlet bed protection.

The depth of the mattress required is dependant upon its application and the conditions prevailing.

Mattresses can be manufactured in any of the welded wire mesh/ wire diameter specifications that are available for gabions. However, the criteria for river or coastal protection works is predominately for flexibility of the unit, therefore the selection criteria is normally for the lighter mesh wires (i.e. 3.0mm PVC coated or 3.0mm Triple life coated dependant upon the environment).

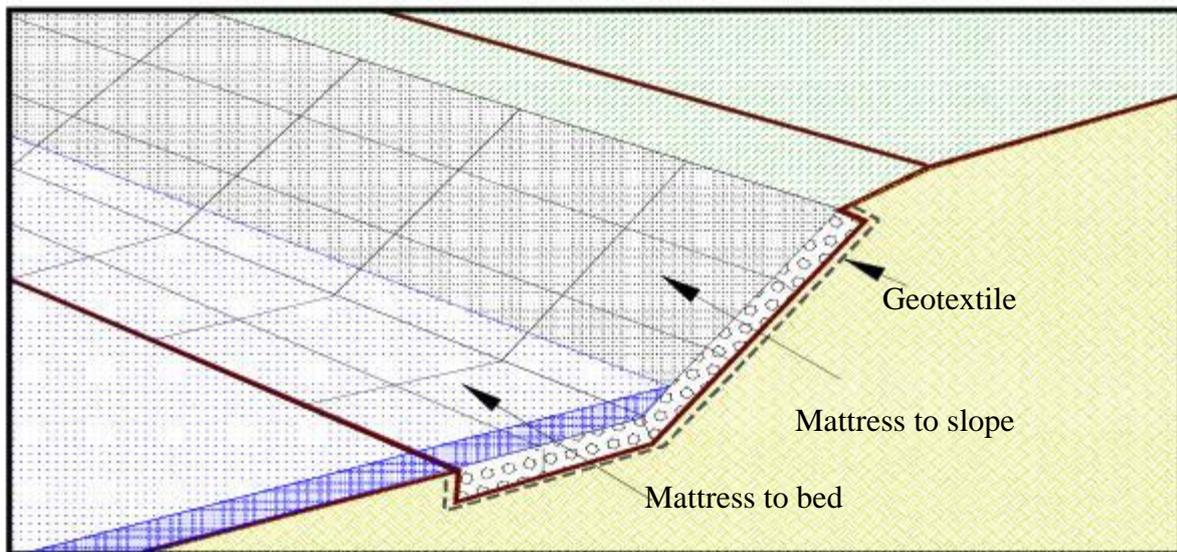
For dry land steep slope reveting where a planar face is required, the heavier wire diameters or a combination of heavier and light wires are more suitable.

In all cases where the units are subject to immersion in saline water or where the quality of water is suspect, then PVC coated units should always be specified.

Units are normally manufactured in plan area of 3mx2m or 6mx2m and of depths specified above. Other units sizes are available together with non standard mesh sizes. Please contact Zhuoda for advise on mesh sizes and availability.

In all gabion and mattress applications a geotextile separator should be specified to be placed behind and/or below to prevent leaching of soil particles.

# RIVER EMBANKMENT PROTECTION



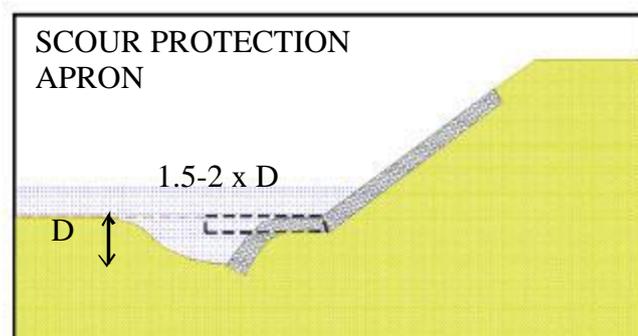
On wide rivers it is not generally a requirement to protect across the full width of the bed of the river. It is normally only required to protect the bed for a distance of 1.5 to 2 times the anticipated scour depth to protect against under scour at the toe of the revetment (See Scour Protection Apron below)

The mattress units should be orientated correctly with the diaphragms parallel to the flow, otherwise stone migration down the slope can occur.

Where the river is navigable and the revetment is subject to wave wash, it is advisable to have an additional diaphragm down the centre of the unit. This gives a maximum cell size of 1m x 1m or 1m x 0.5 dependant on the slope to prevent movement of the stone infill across the unit.

For slopes of up to 1 in 1.75, the cross diaphragm spacing should be no greater than 1m and for slopes of 1 in 1.75 to 1 in 1, the cross diaphragm spacing should be no greater than 0.5m .

The diagram shows the function of the mattress folding down due to scour. An equilibrium point is reached where no further scour will take place provided the apron length is adequate.



# RIVER EMBANKMENT PROTECTION

The Depth of mattress protection is dependant upon the following criteria:-

Soil type :-

With fine soils such as sands and silts are generally more erodable than courser grained soils, the use of a geotextile separator is imperative. The more erodable the soil, the greater the thickness of mattress required.

Flow conditions :-

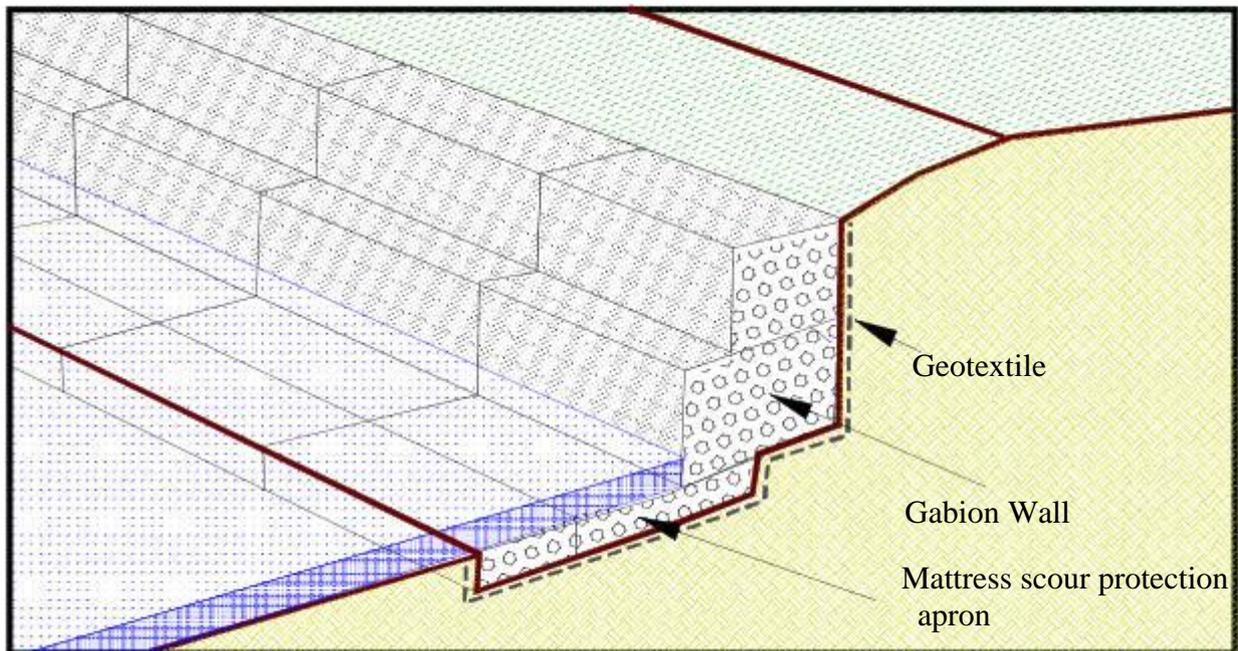
In straight water courses, the flow approaches laminar flow conditions. However, on bends or changes in direction, the flow conditions change to increased water velocity or more turbulent conditions. The greater the water velocity or turbulence, the greater the mattress thickness required.

Where water courses converge or outfalls discharge into the water course or hard structures such as bridge abutments, bridge piers etc are present, turbulent eddy currents will occur which are very erosive and again a greater mattress depth is required

STEADY - LAMINAR FLOW		MATTRESS	DEPTH IN	METRES
Water Velocity	m/s	Soil Type Fine Grained	Soil Type Cohesive	Soil Type Coarse Grained
0 to 2		0.225	0.15	0.15
2 to 4		0.3	0.225	0.15-0.225
4 to 6		0.45	0.3	0.225-0.3
< 6		0.45	0.45	0.3 - 0.45

TURBULENT FLOW		MATTRESS	DEPTH IN	METRES
Water Velocity	m/s	Soil Type Fine Grained	Soil Type Cohesive	Soil Type Coarse Grained
0 to 2		0.3	0.3	0.225
2 to 4		0.3	0.3	0.3
4 to 6		0.45	0.45	0.45
< 6		0.45	0.45	0.45

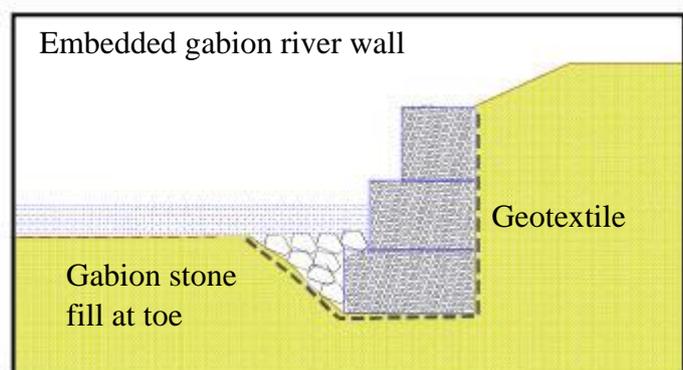
# RIVER WALLING



Where a gabion wall is required to support a river bank, the wall should be designed following the principles for normal gabion retaining wall design, with the retained fill being considered as partially or completely saturated dependant on the rise in water level in the river. However, where there is a rapid draw down situation, hydrostatic pressure can develop and this should be taken into account in the design.

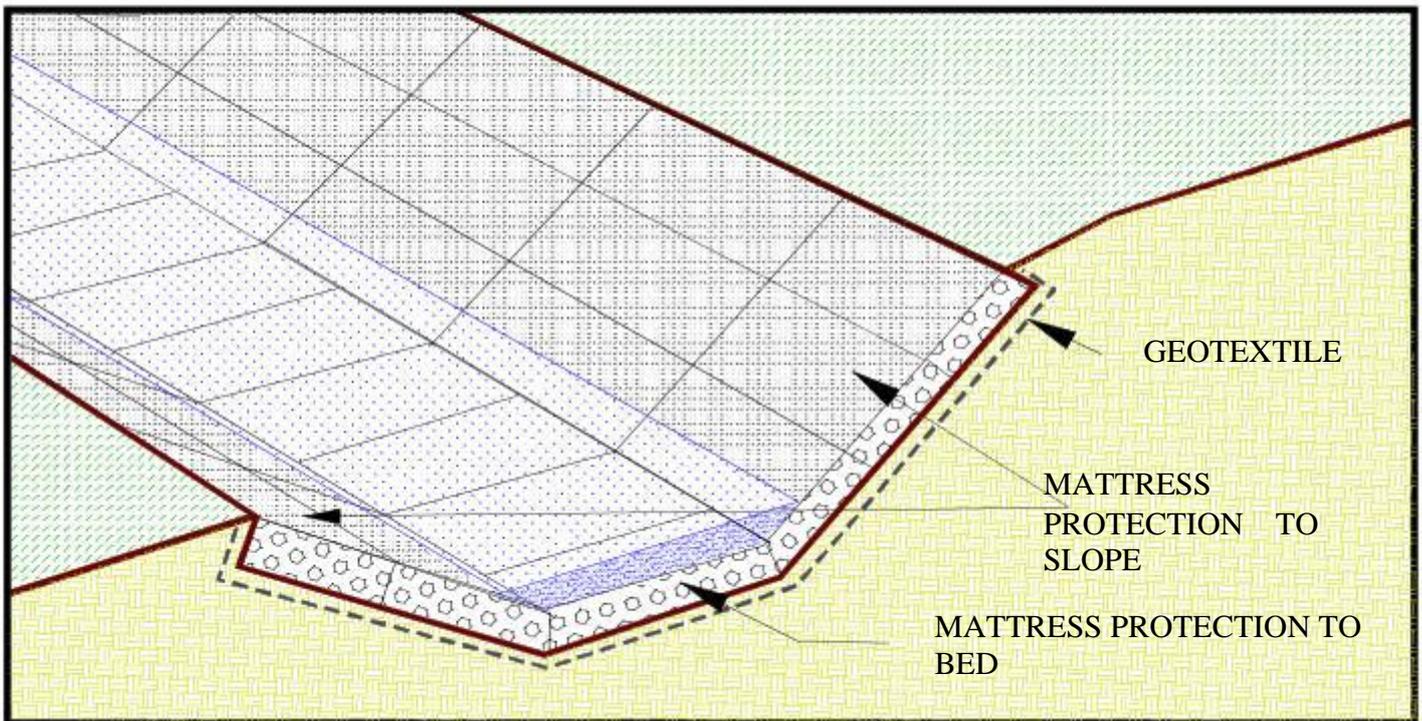
A scour apron is required following the same rules as embankment protection or alternatively the wall needs to be founded below the anticipated scour depth.

Where gabions are embedded, any over excavation should be back-filled with gabion stone laid on a geotextile membrane.



# RIVER DIVERSIONS

## TRAPEZOIDAL CHANNELS



Where it is required to divert a water course, it is generally necessary to protect the new channel against erosion. If the channel is trapezoidal in section, the protection can take the form of a mattress which is laid to each slope and across the river bed.

The depth of the mattress required should follow the criteria laid out in Page 5 and the spacing of diaphragms should correspond to the slope requirements.

It is important again to have the correct orientation of the mattress.....

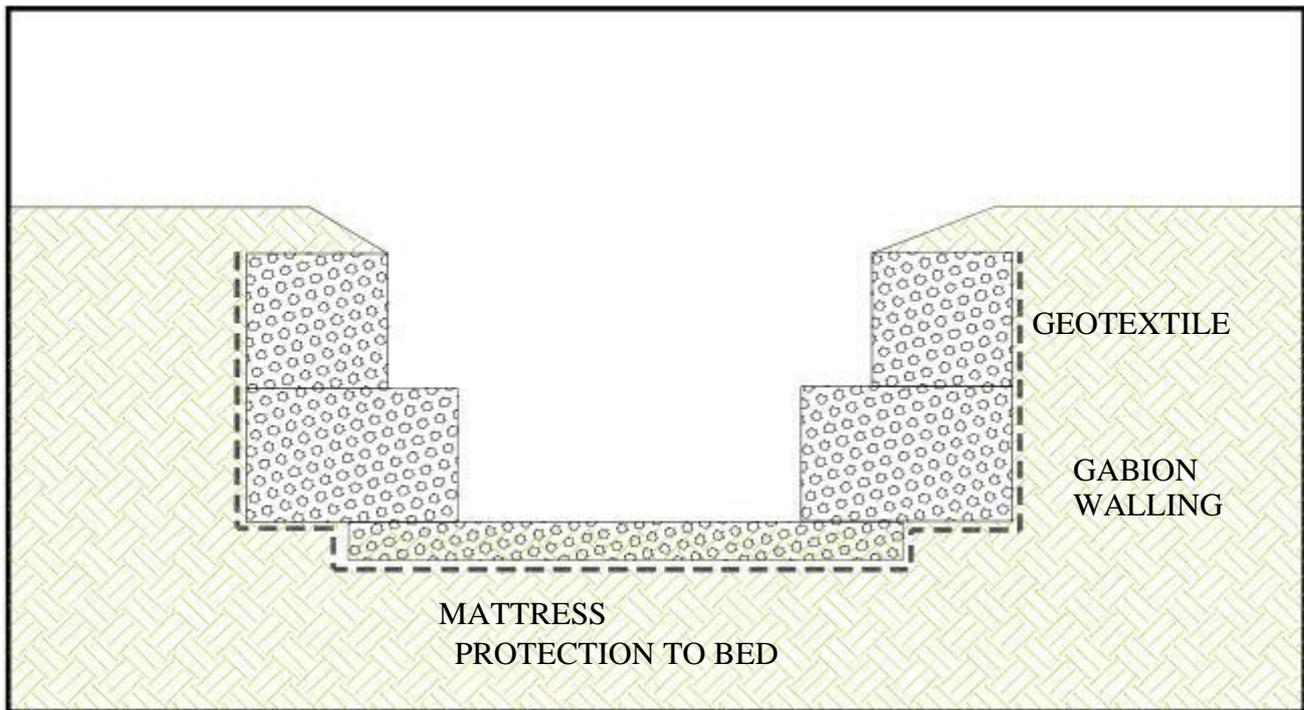
On the slope, the diaphragms are parallel to the water course

On the bed, the diaphragms should be transverse to the direction of flow

In all cases, a geotextile membrane should be placed beneath the mattress units.

# RIVER DIVERSIONS

## RECTANGULAR CHANNELS



Gabion channel walls are again designed as mass gravity walls considering the requirements for draw down and saturated soils.

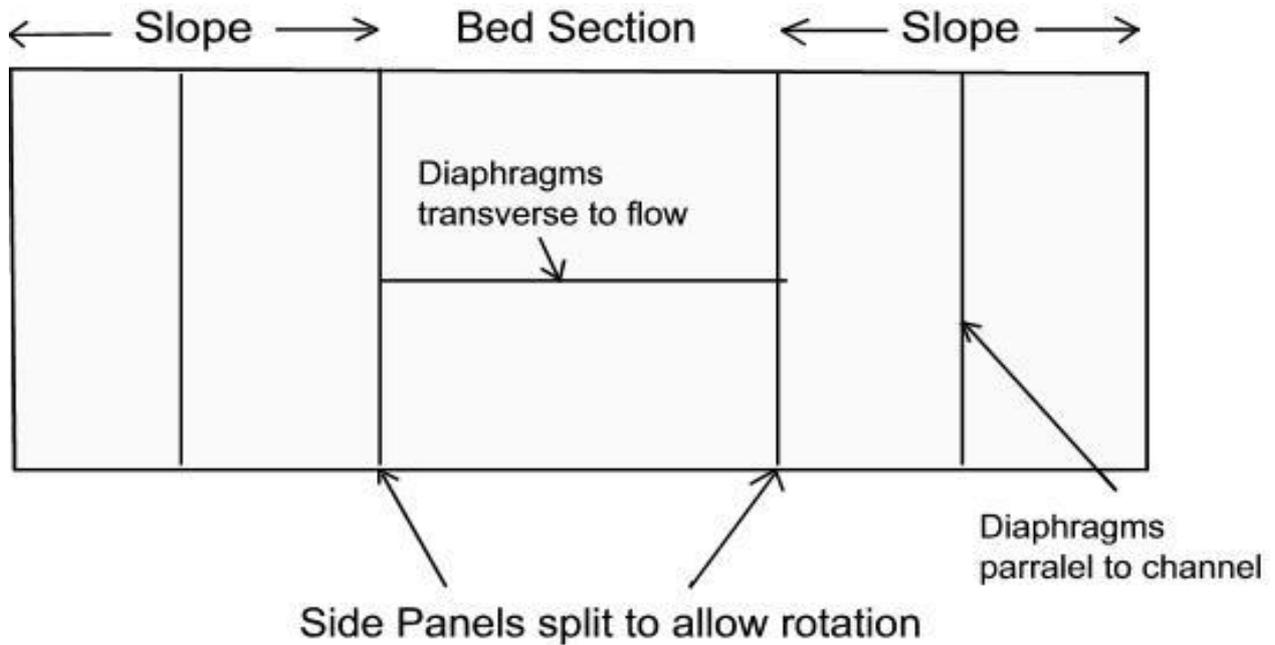
The required mattress depth should be determined from the criteria laid down in Page 5.

It is important again to have the correct orientation of the mattress

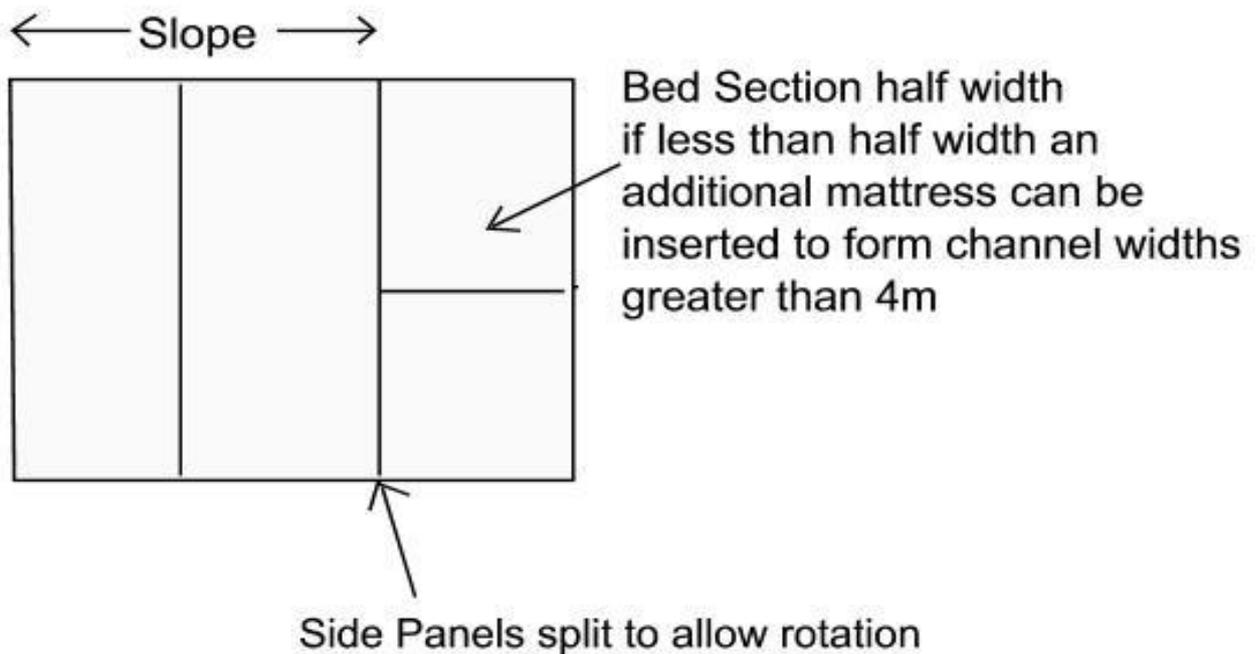
On the bed, the diaphragms should be transverse to the direction of flow.

In all cases a geotextile membrane should be placed beneath the mattress unit and behind the gabion walling.

# BESPOKE UNITS - MATTRESSES



**Plan on full width channel**  
 maximum length 6m  
 maximum width 2m  
 maximum bed width 2m



**Plan on part channel width**  
 maximum length 6m  
 maximum width 2m  
 maximum part bed width 2m

# BESPOKE UNITS -MATTRESS UNITS



FULL CHANNEL UNIT



HALF CHANNEL UNIT MAX BED WIDTH



2 HALF CHANNEL UNIT WITH INFILL MATTRESS UNIT/UNITS

Use of these units is best for larger schemes, units are manufactured to the requirements and can provide savings in construction time.

Diaphragms are oriented according to the previous criteria :- diaphragms to the bed mattress section are transverse to the flow and on the slope sections are parallel to the water course.

The designer should contact Zhuoda to determine the best sizing of the units for the scheme.

# BESPOKE UNITS - COMBINED GABION - MATTRESS UNITS FOR CHANNEL



FULL CHANNEL SECTION MAXIMUM WIDTH 4M



2 HALF CHANNEL UNITS MAXIMUM BED WIDTH 4M



2 HALF CHANNEL UNIT PLUS INFILL MATTRESS UNITS

These units are again manufactured to suit particular schemes and are beneficial in reducing construction costs. The mattress section is integral within the unit.

Diaphragms are orientated across the width of the mattress bed section.

# OUTFALL AND BRIDGE PROTECTION WORKS

Where drainage pipes discharge into water courses or rivers, protection to the bed must be carried out to prevent scour. To achieve this an apron using mattresses is placed in front of the discharge point of the pipe or outlet structure.

Protection may be required to the river bank either side of the structure or discharge point. In the case of streams, it may be necessary to protect the opposite bank against erosion by the discharge.

For bridge abutments and piers, it is necessary to protect the bed and the adjacent banks. Hard structures placed in a river result in turbulent flow conditions or eddies being formed, generally a thicker mattress protection is required (see recommendations on depth of mattress in these conditions on Page 3).

Where a pipe discharges at an elevation above the bed of the river then advice should be sought from the Technical Department.

TABLE OF MATTRESS DEPTH TO DISCHARGE PIPE DIAMETERS

DISCHARGE PIPE DIAMETER mm	RECOMMENDED MATTRESS THICKNESS
150	225mm
225	300mm
300-500	500mm
>500	500mm minimum



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