Quality for Life

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

BEST PRACTICE GUIDE

VERSION # 1 – APRIL 2013

SMALL STREAM EROSION REPAIR

Details contained in this document have been prepared to offer assistance to rural landowners, GWRC staff and Contractors.

The techniques and plans contained in this Guide have been prepared and included on the basis of the information accumulated by GWRC and the experience of GWRC staff over many years in undertaking and supervising repair work. This is made available to offer assistance to rural landowners who experience erosion and are considering whether or not to undertake repairs. The guidelines and plans have been compiled to deal with common or standard situations. Landowners are cautioned against using the guidelines and plans in circumstances which may not be common or standard and are advised to seek professional assistance if in doubt or where there has been significant erosion. While GWRC has endeavoured to ensure the guidelines and plans are a fair statement of the best practice derived from experience, it cannot assume responsibility to any third party for the reliability, accuracy or completeness of the information or plans contained in this Guide or of the applicability of either to any particular circumstances.

In areas of significant erosion, detailed engineering investigation / design may be required.

COVERSHEET
Drawings included within :

- Typical Erosion Scenario
  Dwg Ref : RL-5317/01
- Willows Driven in at Toe of Bank
  Dwg Ref : RL-5317/02
- Re-establish Former Channel and Plant Willows
  Dwg Ref : RL-5317/03
- Taper Back Erosion Face and Plant Willows
  Dwg Ref : RL-5317/04
- Riparian Strip alongside Stream
  Dwg Ref : RL-5317/05
- Shift Channel and Construct Tethered Willows
  Dwg Ref : RL-5317/06
- Tethering (Cabled Willows)
  Dwg Ref : RL-5317/07
- Tree Groynes (Trenching Willows)
  Dwg Ref : RL-5317/08
- Hard Edge Works (Concrete Block or Gabion Groynes)
  Dwg Ref : RL-5317/09
- Pile & Fascine Revetment Protection
  Dwg Ref : RL-5317/10
- Stock Fence across Small Stream
  Dwg Ref : RL-5317/11

For latest version of guide, contact Greater Wellington Regional Council Flood Protection Department

For more information, contact Greater Wellington:

PO Box 11646
Manners Street
Wellington, 6141

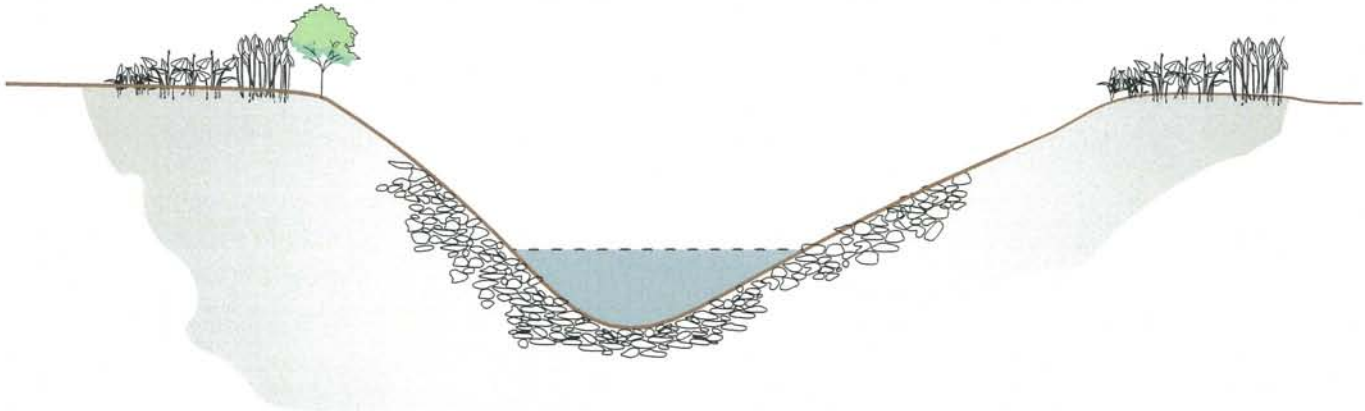
T 04 384 5708
F 04 385 6960

April 2013

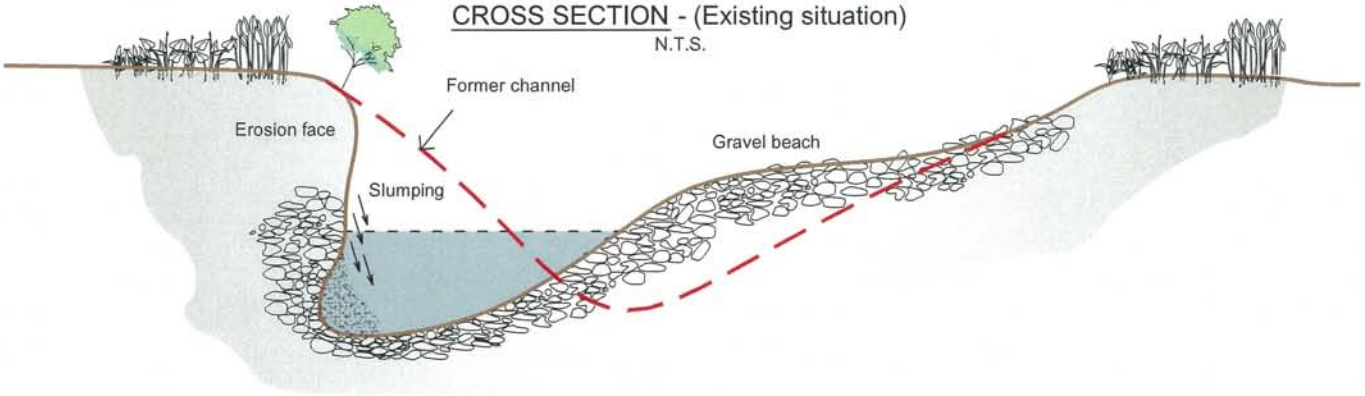
File N//50/03/07 v1

e-doc #1178298

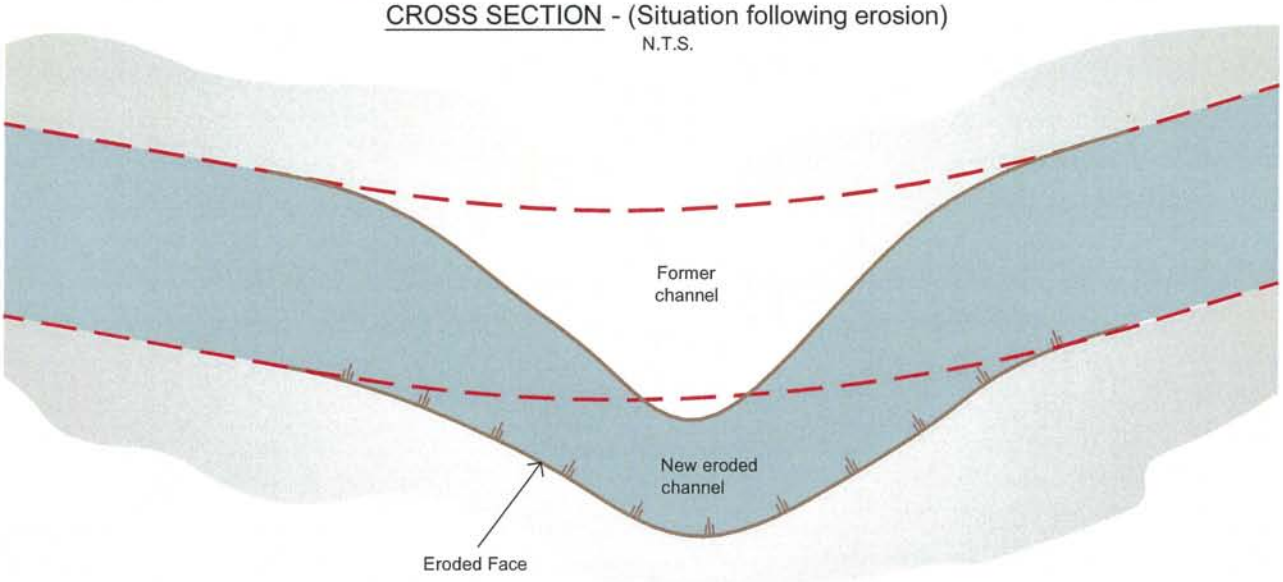
www.gw.govt.nz
info@gw.govt.nz



CROSS SECTION - (Existing situation)
N.T.S.



CROSS SECTION - (Situation following erosion)
N.T.S.



PLAN - (Situation following erosion)
N.T.S.

EROSION STARTS

- In a flood the stream has greater turbulence and increased energy. Pieces of bank get carried away causing erosion to stream banks and stream bed.
- As the volumes and velocities of water increases the stream bed mobilizes and gravel is transported down the stream.
- At the erosion site the channel is now wider. As water velocities naturally slow on the inside of a bend gravel begins to deposit.
- A gravel beach builds up opposite the erosion site, narrowing and squeezing the stream channel and increasing velocities which encourages further bank erosion.
- As the Stream channel is now narrower, a scour hole has formed exposing raw bank now at risk of collapse from constant erosion and excavation by the next flood .

PREVENTING FURTHER EROSION

A variety of methods can be used to try and prevent further erosion.

Some of these methods have been outlined in this drawing series RL-5317 (Standard Details - River / Small Stream Erosion Repair) by Greater Wellington's Flood Protection Department .

The methods attempt to stabilize the stream by addressing one or more of the issues outlined in the bullet points to the left.

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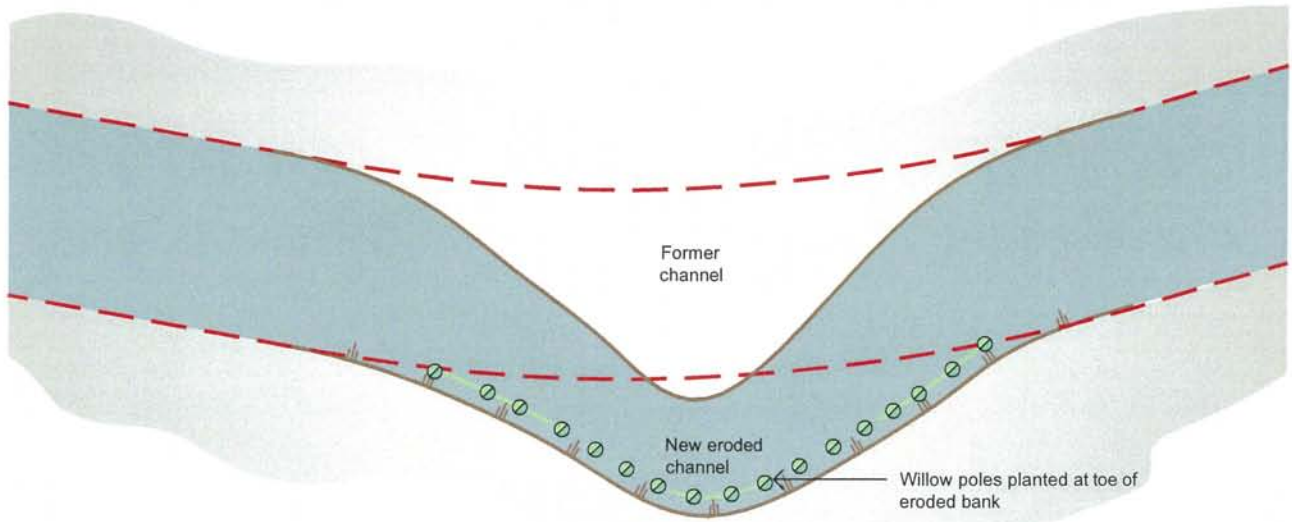
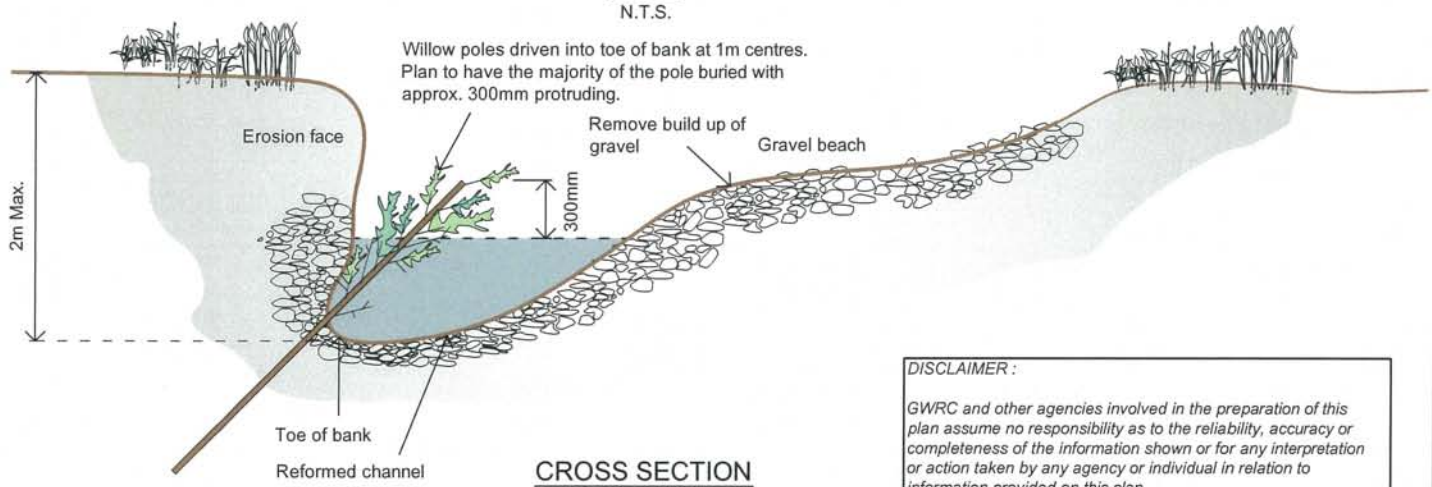
VERSION #	EROSION REPAIR			
1		DESIGN	COMPILED	April 2013
		DRAWN	P.COOK	April 2013
	SMALL STREAM STANDARD DETAIL	CHECKED	C.C.Mum	3/5/13
		APPROVED	[signature]	6/5/13
	TYPICAL CHANNEL MOVEMENT / EROSION SCENARIO	Drawing No.	RL-5317 / 01	
		FILE N/50/2/6	Cad: RL-5317_C.dwg	



PLAN
N.T.S.



CROSS SECTION
N.T.S.

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See also caution on cover sheet

OBJECTIVE

To use willows to secure the eroding bank edge and willow foliage to protect the upper Erosion face from flood velocities. Regular removal of gravel build up on the beach opposite is required to lower the pressure on the willows.

MATERIALS

Use cut poles of a multi-stemmed Osier willow e.g. Salix Purpurea 'Booth'. Poles should be 50mm Ø Min. Plan to have the majority of the pole buried with 300mm approx. protruding.
Use a heavy steel bar to prepare a hole if possible, then drive in the willow pole. Plant poles at 1m spacing.

LIKELIHOOD OF SUCCESS

Initially low until willows establish an effective root system. This could take up to 4 - 5 years in difficult soils.

Perseverance, timely maintenance and no floods during establishment may assist with success.

NOTES :

Not appropriate where significant assets are at risk.
Not practical if scour hole is too deep.
Not practical in large gravels.
Must be protected from grazing stock.
Vulnerable to abrasion damage in floods.

PLANTING WILLOW POLES

Poles should be cut from modern sterile hybrid stock. If poles are purchased the seller should certify source and breeding. Sterile hybrid willows have been specially developed for river protection work with extensive root systems, quick growth and large girths while limiting seeding, brittleness and wild strike.

The preferred osier willow is Salix Matsudana x Salix alba sterile hybrid "Moutere". These willows reach up to 6m in 2yrs or > 20m on maturity.

Willow poles should be collected and planted when the tree is dormant (June - July). To ensure success the poles should be planted immediately after collection. If kept moist, poles will remain viable for a considerable time.

Hand planting in gravel should be assisted by an excavator or bulldozer with a ripping tyne or a tractor with a motorized auger.

To guarantee success poles must be planted deep enough to ensure their root system has access to moisture all year round. This means plant as deep as practical.

In silty soils it is often possible to drive poles in by hand. A heavy steel bar is useful to prepare a hole. Often a fence post hand driver can be use to drive large poles. An end cap can be made from a length of suitable steel tube. This is slid over the poles and then the pole driven in with a heavy hammer. Allow to cut the damaged top off the pole with a chain saw.

An excavator can sometimes be used to push poles into place.

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VERSION #
1

EROSION REPAIR

SMALL STREAM
STANDARD DETAIL
WILLOWS DRIVEN IN AT TOE OF BANK

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
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APPROVED	[signature]	6/5/13
Drawing No.	RL-5317 / 02	
FILE N/50/2/6	Cad: RL-5317_C.dwg	

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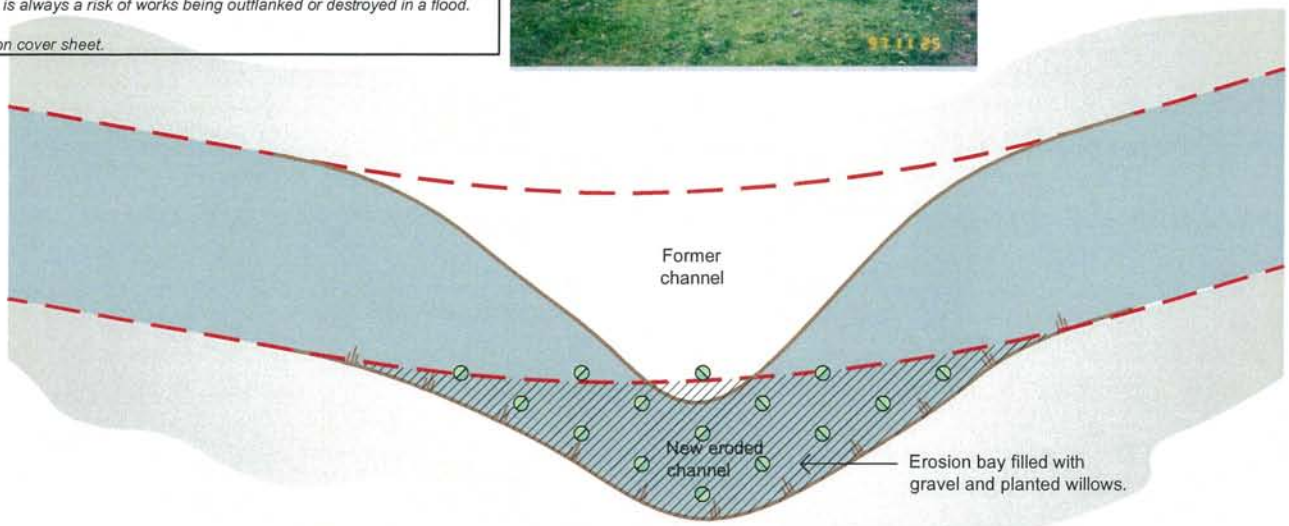
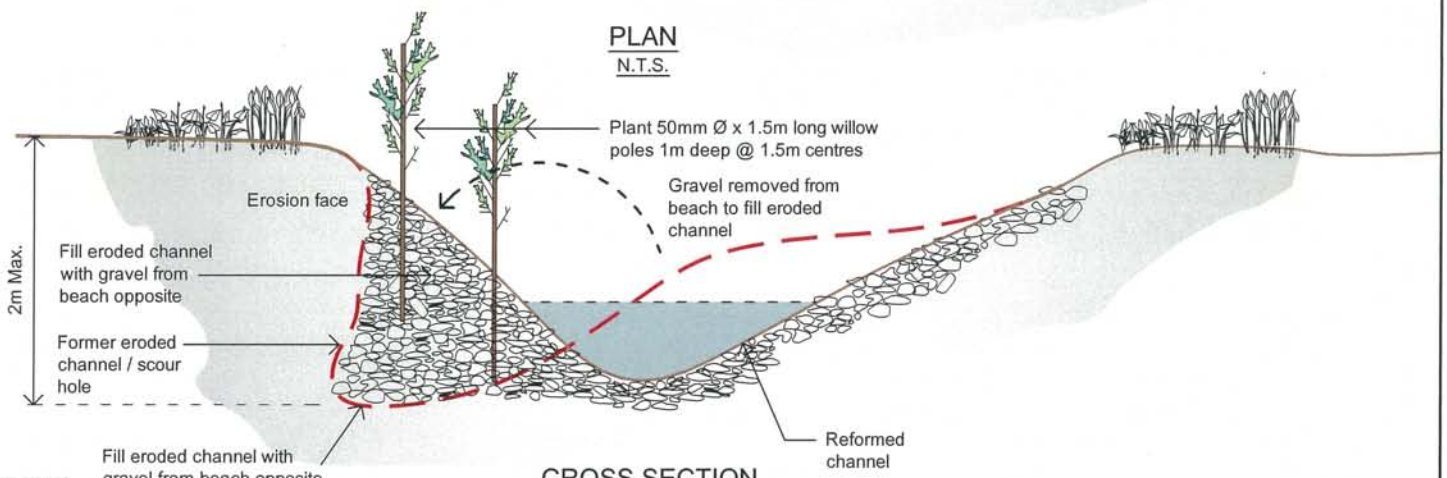
See also caution on cover sheet.



PLAN
N.T.S.



CROSS SECTION
N.T.S.

OBJECTIVE

To reduce the risk of further damage by shifting the channel off the Erosion face and planting willow poles to prevent the channel returning

MATERIALS

Use cut poles of a multi-stemmed Osier willow e.g. Salix Purpurea 'Booth' . Poles should be 50mm Ø Min. x 1.5m long.

METHOD

Use an excavator to shift the channel off the erosion by using gravels from the beach opposite. Plant poles 1m in and 0.5m out @ 1.5m centres in shifted gravel as work proceeds. Alternatively push poles into loose gravels with digger bucket.

If the worked gravels are silty, establishing a grass cover may help with protection.

LIKELIHOOD OF SUCCESS

Reasonable, provided damage is repaired quickly. Losses are likely in the initial years as the willows establish (up to 3 - 5 years). The loose gravel is also vulnerable to further erosion in a flood

Note :

Not appropriate where significant assets are at risk.
Must be protected from grazing stock.

PLANTING WILLOW POLES

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The preferred osier willow is Salix Matsudana x Salix alba sterile hybrid "Moutere". These willows reach up to 6m in 2yrs or > 20m on maturity.

Willow poles should be collected and planted when the tree is dormant (June - July). To ensure success the poles should be planted immediately after collection. If kept moist, poles will remain viable for a considerable time.

Hand planting in gravel should be assisted by an excavator or bulldozer with a ripping tyne or a tractor with a motorized auger.

To guarantee success poles must be planted deep enough to ensure their root system has access to moisture all year round. This means plant as deep as practical.

In silty soils it is often possible to drive poles in by hand. A heavy steel bar is useful to prepare a hole. Often a fence post hand driver can be use to drive large poles. An end cap can be made from a length of suitable steel tube. This is slid over the poles and then the pole driven in with a heavy hammer. Allow to cut the damaged top off the pole with a chain saw.

An excavator can sometimes be used to push poles into place.

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VERSION #
1

EROSION REPAIR

SMALL STREAM
STANDARD DETAIL
RE-ESTABLISH Former channel and PLANT WILLOWS

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
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APPROVED		6/5/13
Drawing No.	RL-5317 / 03	
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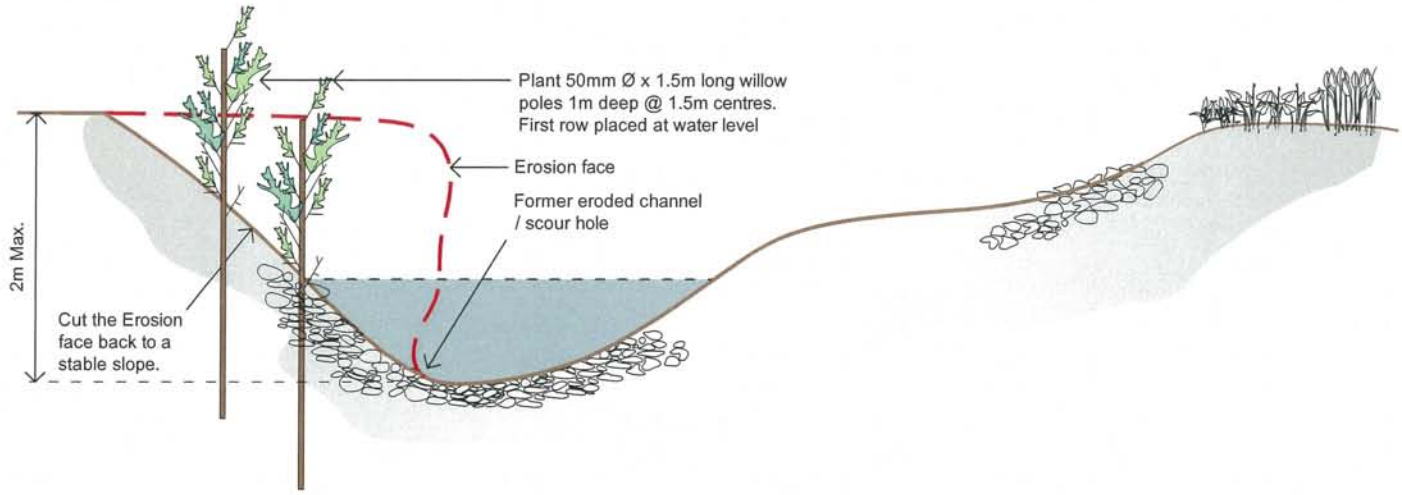
See also caution on cover sheet.



CROSS SECTION
N.T.S.

OBJECTIVE

To reduce the risk of further erosion by increasing the waterway width and thereby lowering velocities. To improve stability at the site by taking the Erosion face back to a more suitable slope and planting willows

MATERIALS

Use cut poles of a multi-stemmed Osier willow e.g. Salix Purpurea 'Booth'. Poles should be 50mm Ø Min. x 1.5m long.

METHOD

Use an excavator to cut the eroded face back to a stable slope. Plant poles 1m in and 0.5m out @ 1.5m centres. in the cut face with first row at the waterline.

LIKELIHOOD OF SUCCESS

Reasonable. Increases with time as willows establish (up to 3 - 5 years) but perseverance, timely maintenance and few floods will increase success.

Note :

Not appropriate where significant assets are at risk.
Must be protected from grazing stock.

PLANTING WILLOW POLES

Poles should be cut from modern sterile hybrid stock. If poles are purchased the seller should certify source and breeding. Sterile hybrid willows have been specially developed for river protection work with extensive root systems, quick growth and large girths while limiting seeding, brittleness and wild strike.

The preferred osier willow is Salix Matsudana x Salix alba sterile hybrid "Moutere". These willows reach up to 6m in 2yrs or > 20m on maturity.

Willow poles should be collected and planted when the tree is dormant (June - July). To ensure success the poles should be planted immediately after collection. If kept moist, poles will remain viable for a considerable time.

Hand planting in gravel should be assisted by an excavator or bulldozer with a ripping tyne or a tractor with a motorized auger.

To guarantee success poles must be planted deep enough to ensure their root system has access to moisture all year round. This means plant as deep as practical.

In silty soils it is often possible to drive poles in by hand. A heavy steel bar is useful to prepare a hole. Often a fence post hand driver can be use to drive large poles. An end cap can be made from a length of suitable steel tube. This is slid over the poles and then the pole driven in with a heavy hammer. Allow to cut the damaged top off the pole with a chain saw.

An excavator can sometimes be used to push poles into place.

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VERSION #
1

EROSION REPAIR

SMALL STREAM
STANDARD DETAIL
TAPER BACK Erosion face and PLANT WILLOWS

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
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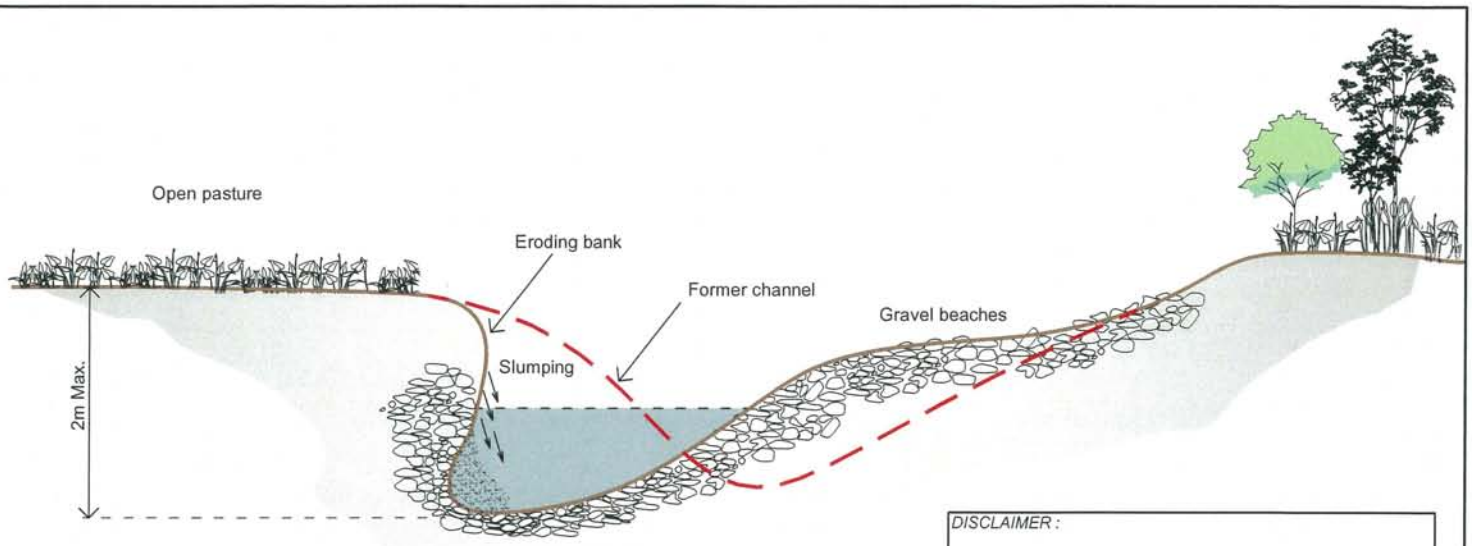
APPROVED		6/5/13
Drawing No.	RL-5317 / 04	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



EXISTING PROFILE
(Showing erosion)
N.T.S.

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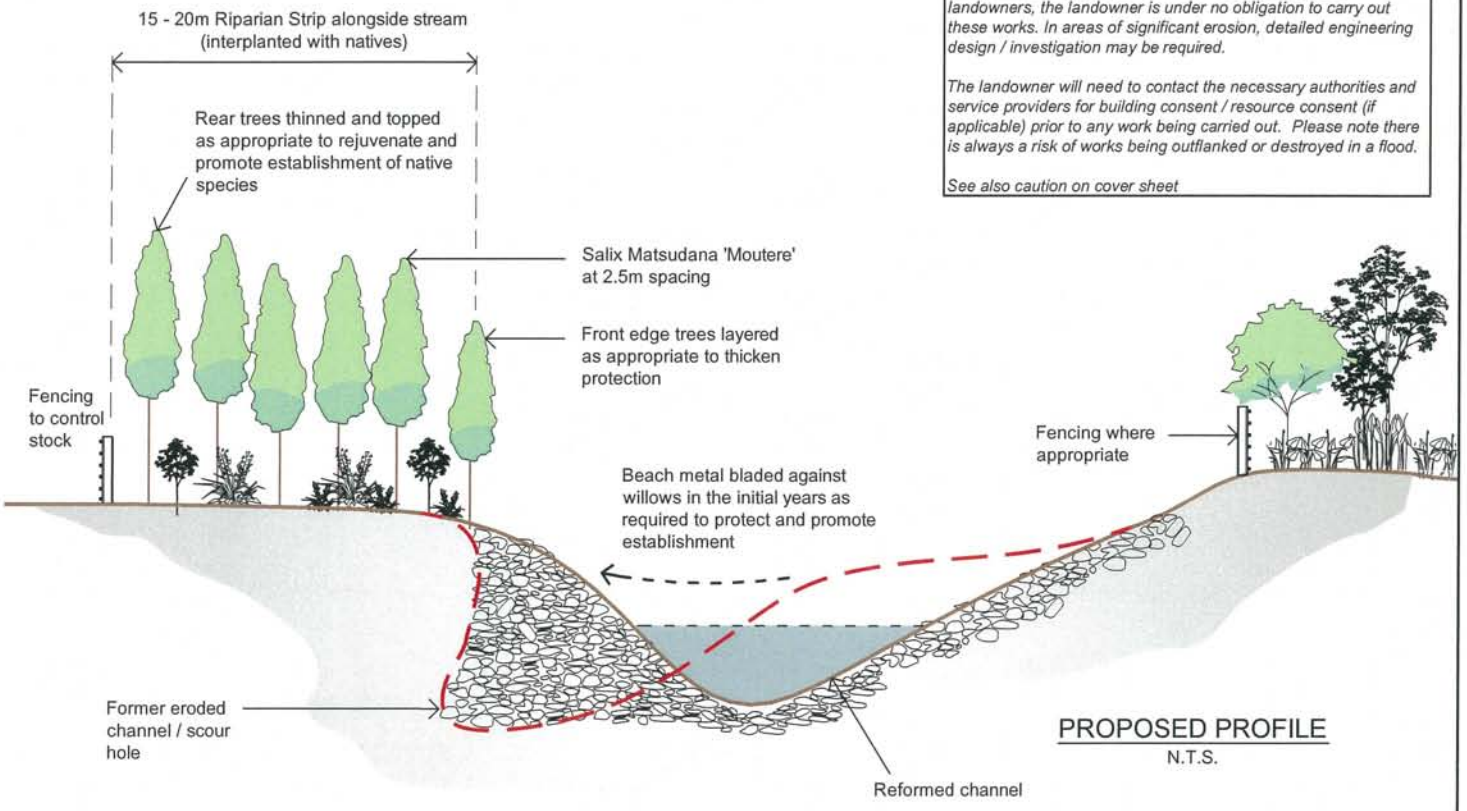

PROPOSED PROFILE
N.T.S.

PLANTING WILLOW POLES

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The preferred osier willow is Salix Matsudana x Salix alba sterile hybrid "Moutere". These willows reach up to 6m in 2yrs or > 20m on maturity.

Willow poles should be collected and planted when the tree is dormant (June - July). To ensure success the poles should be planted immediately after collection. If kept moist, poles will remain viable for a considerable time.

Hand planting in gravel should be assisted by an excavator or bulldozer with a ripping tyne or a tractor with a motorized auger.

To guarantee success poles must be planted deep enough to ensure their root system has access to moisture all year round. This means plant as deep as practical.

In silty soils it is often possible to drive poles in by hand. A heavy steel bar is useful to prepare a hole. Often a fence post hand driver can be use to drive large poles. An end cap can be made from a length of suitable steel tube. This is slid over the poles and then the pole driven in with a heavy hammer. Allow to cut the damaged top off the pole with a chain saw.

An excavator can sometimes be used to push poles into place.

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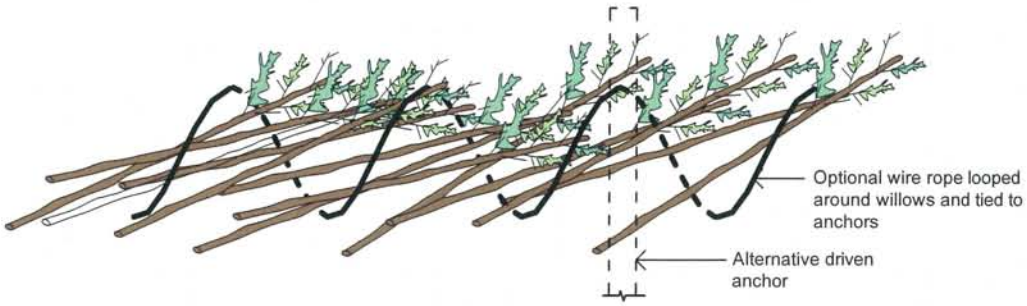
VERSION #
1

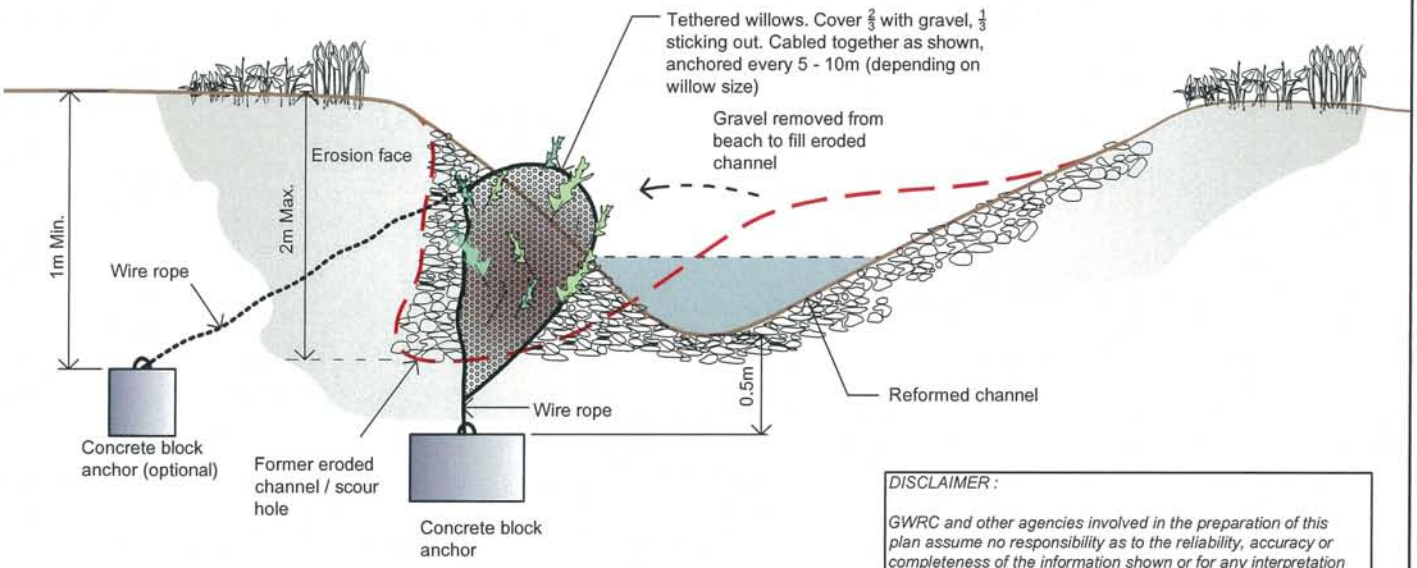
EROSION REPAIR

SMALL STREAM
STANDARD DETAIL
RIPARIAN STRIP ALONGSIDE STREAM

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
CHECKED	C.C. Mann	3/5/13
APPROVED	[signature]	6/5/13
Drawing No.	RL-5317 / 05	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



DETAIL
N.T.S.



CROSS SECTION
N.T.S.

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See also caution on cover sheet.

OBJECTIVE

To reduce the risk of further erosion by shifting the channel off the erosion and construct a barrier of live willows. The bundled willows provide a physical barrier (which increases as they grow) against stream velocities.

MATERIALS

Use large branches of tree willows (Matsuda or similar preferred)
Heavy wire rope.
Concrete blocks or Rail irons as anchors.

METHOD

Use an excavator to shift the channel off the erosion. Excavate a trench and place large willow branches in a bundle in the trench. Place on a slope with their butts in the water and their branches up (refer to diagram top of page). Tie down securely with wire rope to the anchors (either concrete blocks or driven Rail irons). Use excavator to throw gravel over the willows so they are ⅔ covered ⅓ out.

LIKELIHOOD OF SUCCESS

Good provided they stay well secured and any maintenance is carried out promptly.

NOTES :

Must be protected from grazing stock.
Not appropriate where significant assets are at risk.

PLANTING WILLOW POLES

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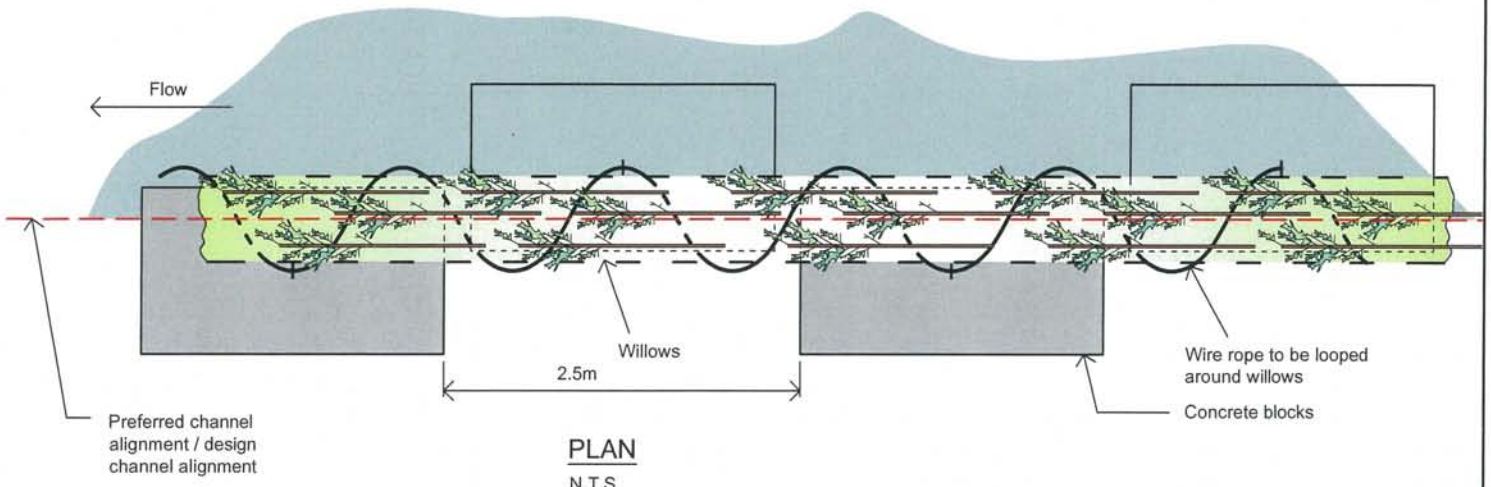
VERSION #
1

EROSION REPAIR

SMALL STREAM
STANDARD DETAIL
SHIFT CHANNEL and CONSTRUCT
TETHERED WILLOWS

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
CHECKED	C.C. MUNN	3/5/13
APPROVED		6/5/13
Drawing No.	RL-5317 / 06	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



PLAN
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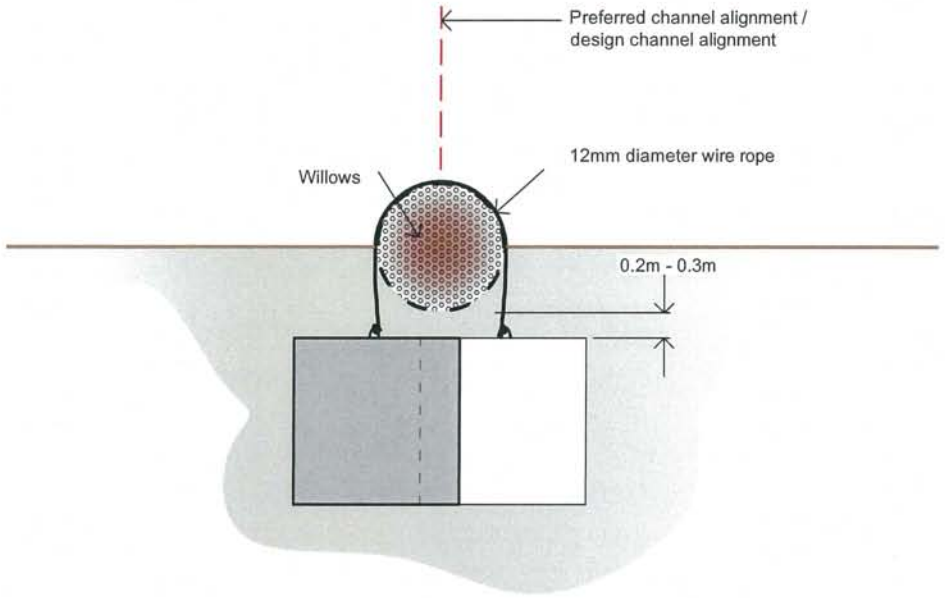

ELEVATION
N.T.S.

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See also caution on cover sheet.

NOTES :

- Where the willow trees or branches overlap, the upstream willow is to be on the outside (riverside).

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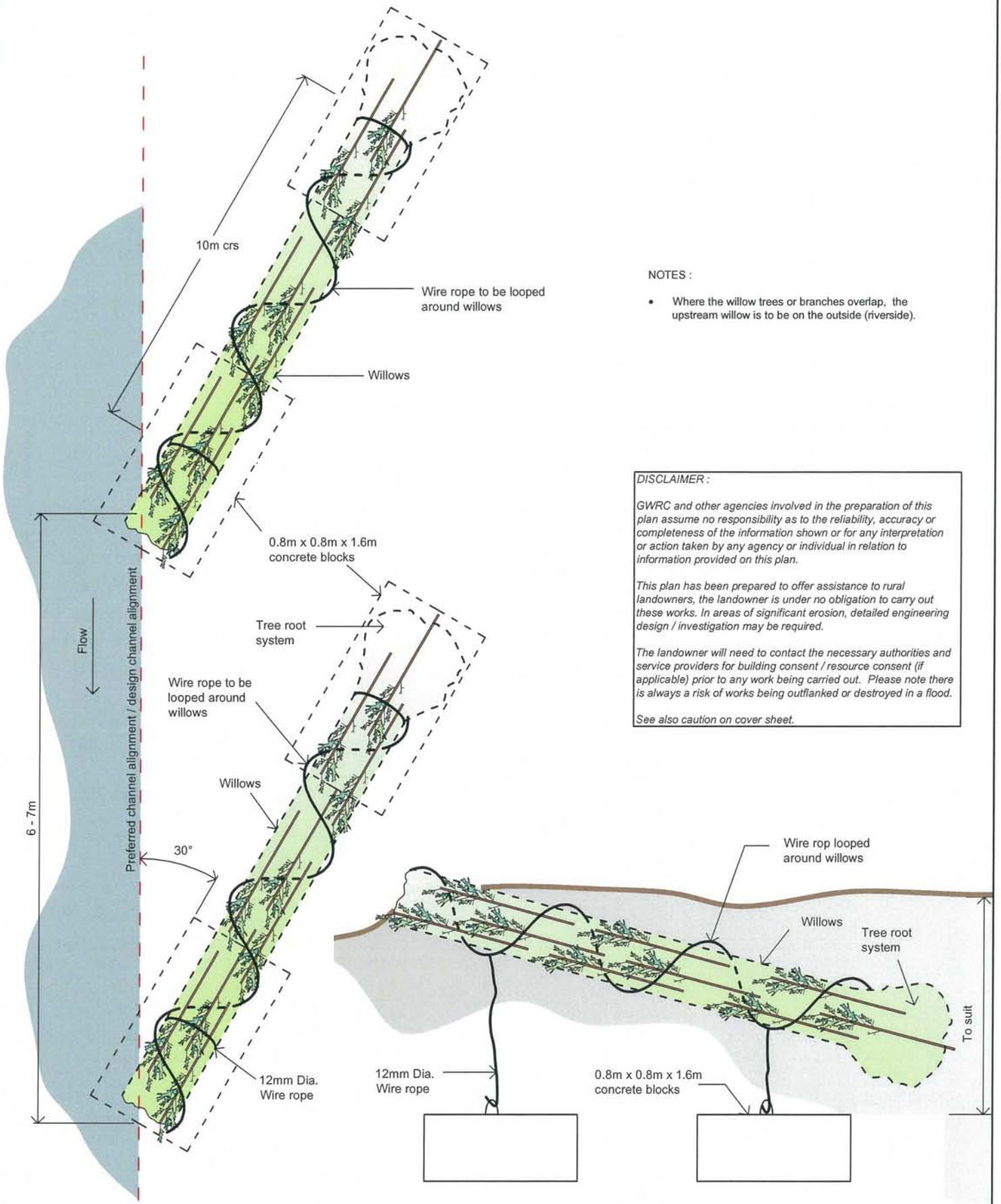
VERSION #
1

EROSION REPAIR

SMALL STREAM / RIVER
STANDARD DETAIL
TETHERING (CABLED WILLOWS)

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
CHECKED	C.C.MUNN	3/5/13
APPROVED		6/5/13
Drawing No.	RL-5317 / 7	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



NOTES :

- Where the willow trees or branches overlap, the upstream willow is to be on the outside (riverside).

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See also caution on cover sheet.

PLAN
N.T.S.

ELEVATION
N.T.S.

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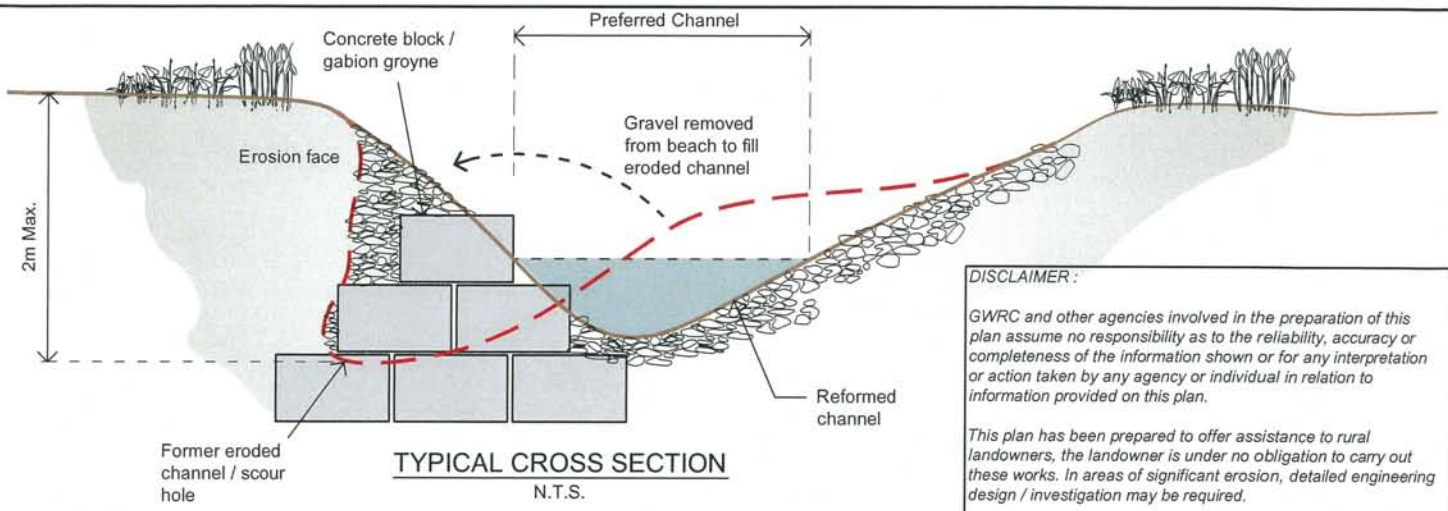
VERSION #
1

EROSION REPAIR

SMALL STREAM / RIVER
STANDARD DETAIL
TREE GROYNES (TRENCHING WILLOWS)

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
CHECKED	C.C.MUNN	3/5/13
APPROVED		6/5/13
Drawing No.	RL-5317 / 8	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



TYPICAL CROSS SECTION
N.T.S.

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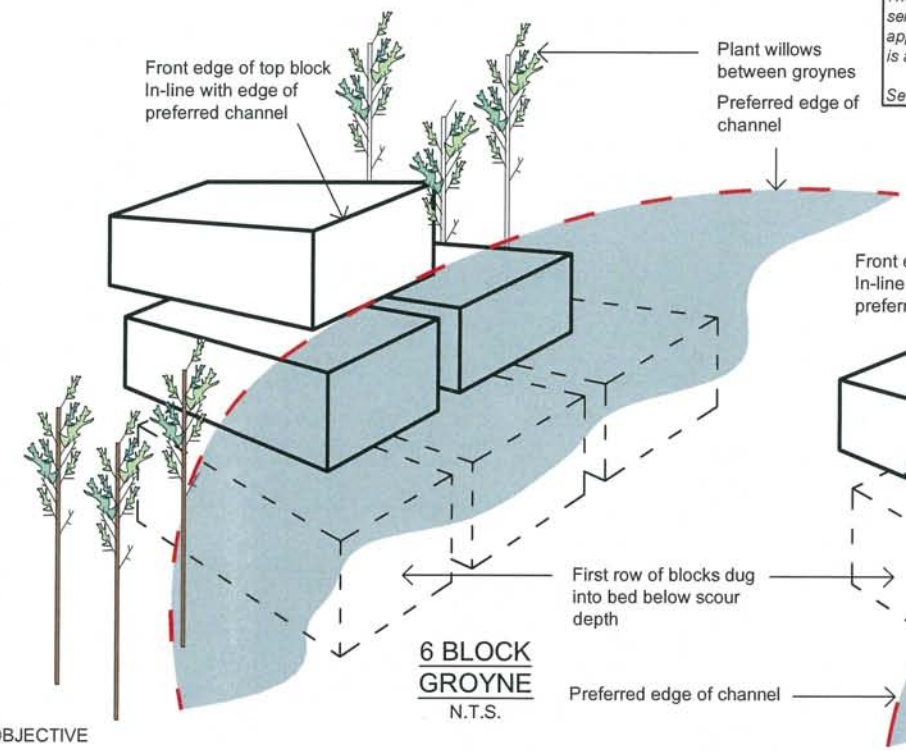
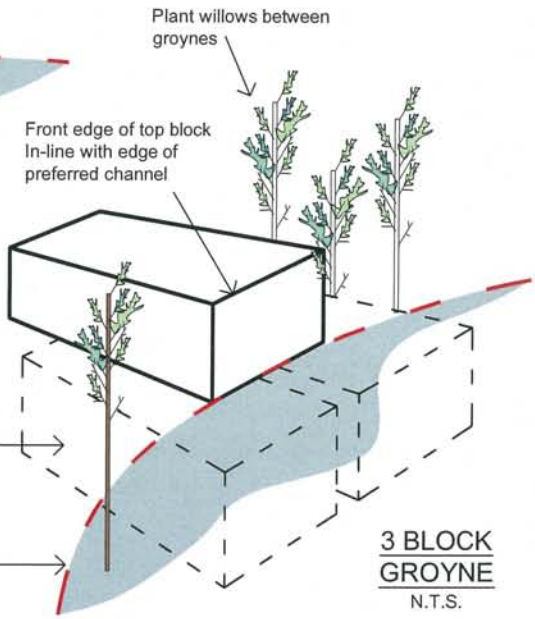
See also caution on cover sheet.



6 BLOCK GROYNE
N.T.S.



3 BLOCK GROYNE
N.T.S.

OBJECTIVE

To repair the existing erosion and return the channel to its prior alignment and hold it there by constructing hard edge works with either concrete blocks or gabion baskets.

MATERIALS

Use 0.8m x 0.8m x 1.6m concrete blocks (or similar) preferably with centre holes or lifting eyes for wire rope to loop through.
14mm Ø wire rope.
Wire clamps.
Tree willow poles (Moutere).

METHOD

Use an excavator to shift the flow channel back to its pre-erosion alignment. Fill the current erosion with gravel excavated from the proposed 'restored channel alignment' or from the built up beaches opposite.

Construct a series of concrete block groynes along the outside edge of the alignment. Blocks set back $\frac{1}{4}$ to $\frac{1}{3}$ of block length and roped together securely.

Groyne spacing is a judgment call depending on factors such as tightness of the bend, stream gradient and bank material etc. A general rule of thumb is : Groyne spacing = 1.5 x the distance between Erosion face and preferred channel alignment.

Install groyne pointing slightly upstream with a slight lean forward

All blocks to be roped together with 14mm Ø wire rope so they act as a single unit.

It is essential that the bottom layer of blocks is below scour depth or the groynes will rapidly fail.

The large groyne (6 block) is normally used at the apex of the bend.

The area between the groynes is then mass planted with willow poles.

LIKELIHOOD OF SUCCESS

Good, provided the bottom layer is well founded below scour depth and all blocks secured together with wire rope to act as one unit.

NOTES :

Willows must be protected from grazing stock.
Gabions may be substituted for concrete blocks (all the above applies except that in some circumstances gabions have a shorter life).
Gabions will likely be damaged & fail in highly mobile gravel beds.

Refer to drawings HR-5317 / 2 to 4 for notes on planting willows

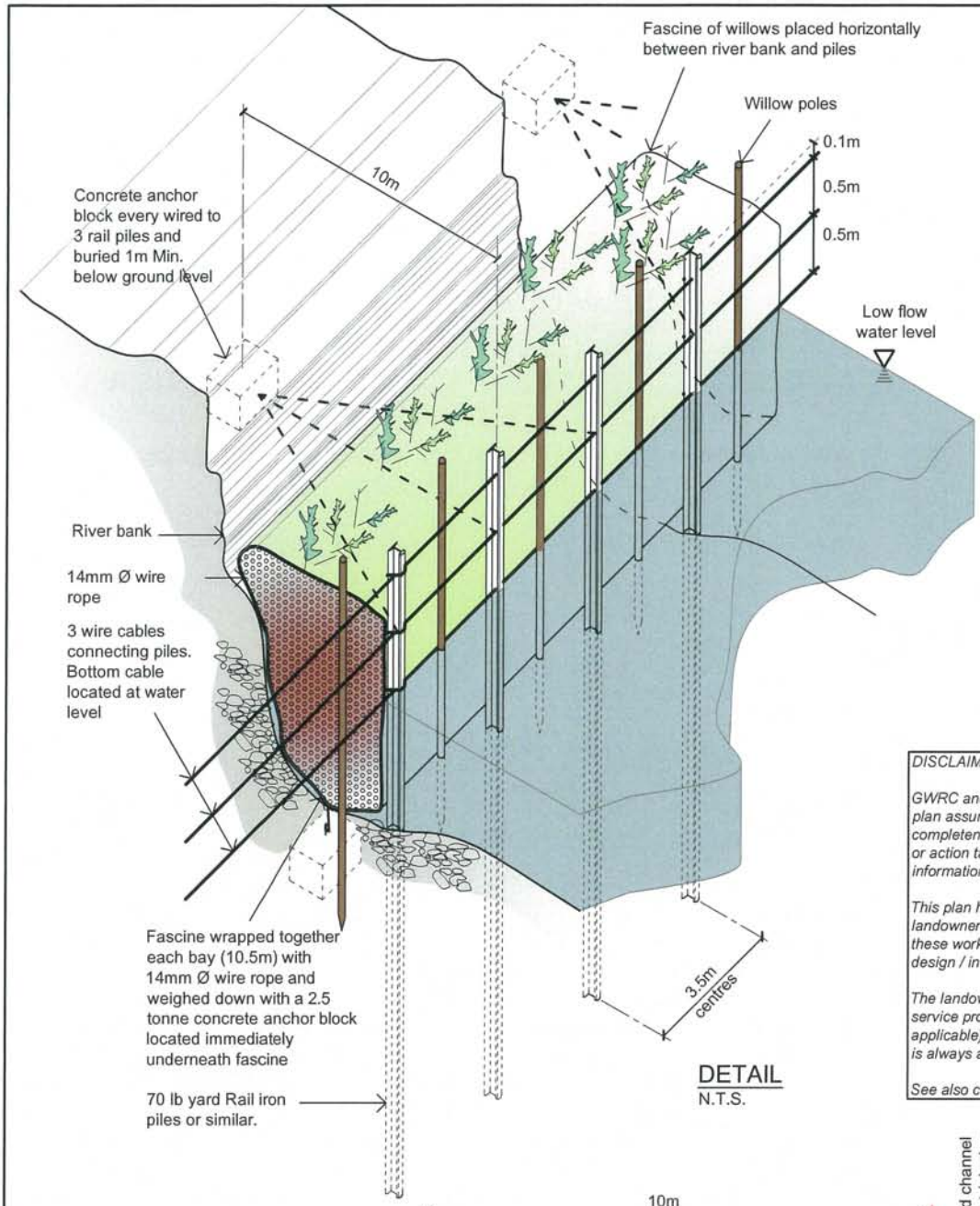
greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

VERSION #
1

EROSION REPAIR

SMALL STREAM
STANDARD DETAIL
Hard Edge Works (Concrete Block or Gabion Groynes)

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
CHECKED	C.C.Munn	3/5/13
APPROVED		6/5/13
Drawing No.	RL-5317 / 09	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



DETAIL
N.T.S.

NOTES :

- All irons to be in good condition without significant corrosion.
- Wire cable to be 14mm Ø 3 x 19 Galvanised wire rope.
- Cables tied off every eighth iron (28m).
- Cable tensioned to a nominal strain using a "come-along" or "Turfer" winch.
- In each bay the fascine is to be cabled together and weighted with a 2.5 tonne concrete anchor block located immediately underneath the fascine.
- Every set of three adjoining Railway irons to be tied back to a 2.5 tonne concrete anchor block located 10m from the line of the rail piles and buried 1m Min. below ground level.
- Where the willow trees or branches overlap, the upstream willow is to be on the outside (riverside).
- Rail piles to be located on the river design channel / preferred channel alignment. The area between the river bank and piles is to backfilled with river gravels as necessary.
- At the upstream end the rail piles and wire cables are to be returned into the bank as a Rail iron groyne 4 bays into the bank.
- Refer also GWRC Drawing A2-9459 / 1-RC for further details.

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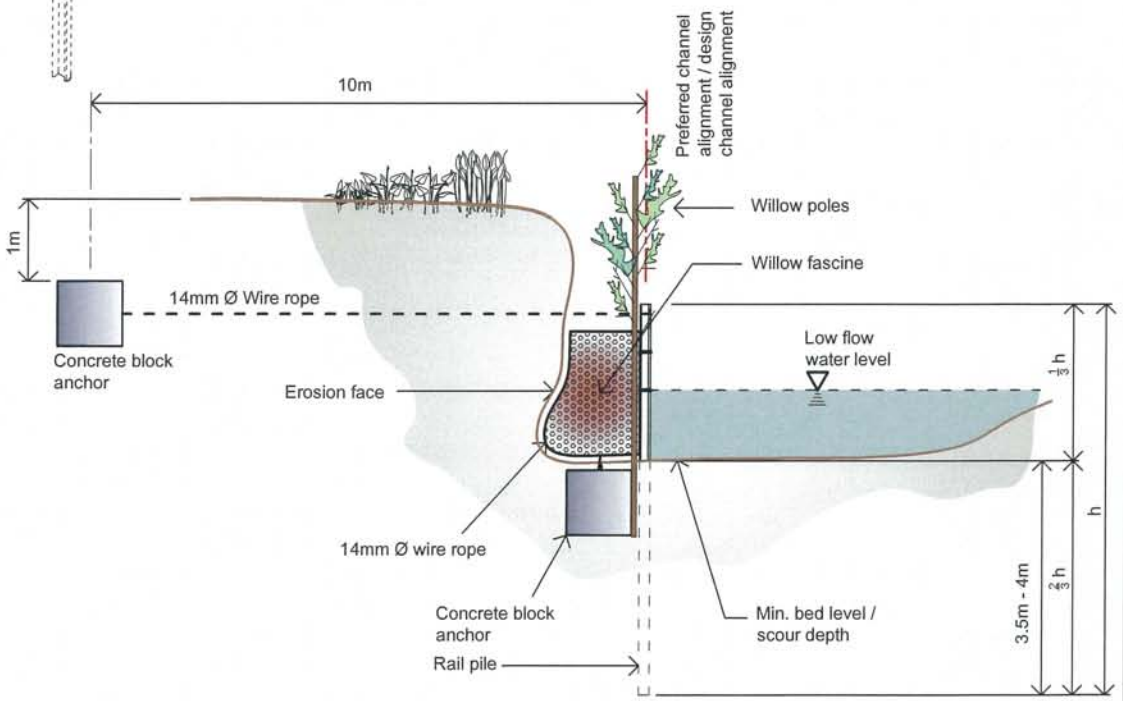

CROSS SECTION N.T.S.

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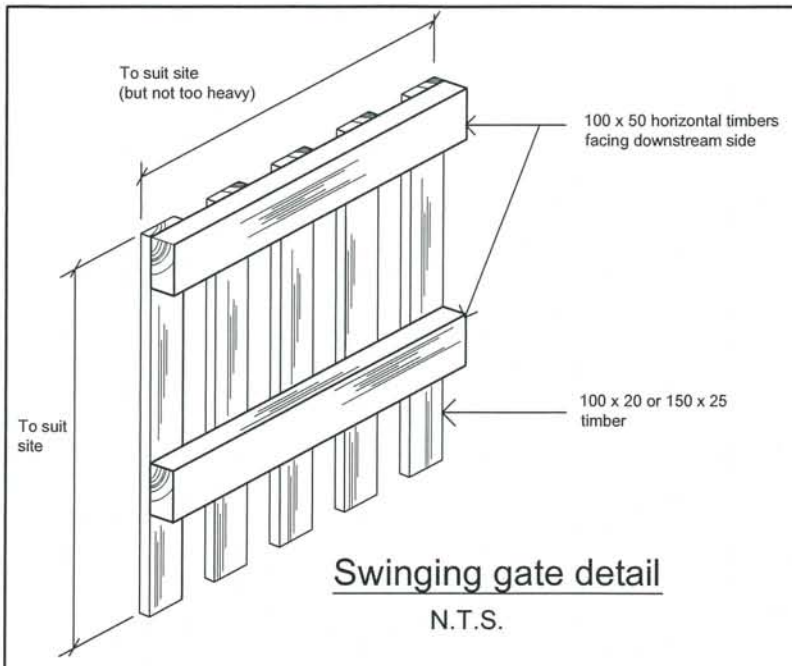
VERSION #
1

EROSION REPAIR

SMALL STREAM / RIVER
STANDARD DETAIL
PILE and FASCINE REVETMENT PROTECTION

DESIGN	COMPILED	April 2013
DRAWN	P.COOK	April 2013
CHECKED	C.C-MUNN	3/5/13
APPROVED		6/5/13
Drawing No.	RL-5317 / 10	
FILE N/50/2/6	Cad: RL-5317_C.dwg	



Swinging gate detail

N.T.S.

NOTES :

- These gates float in a flood and pose minimum restriction to flows and catch minimum debris.
- All timber to be treated as required

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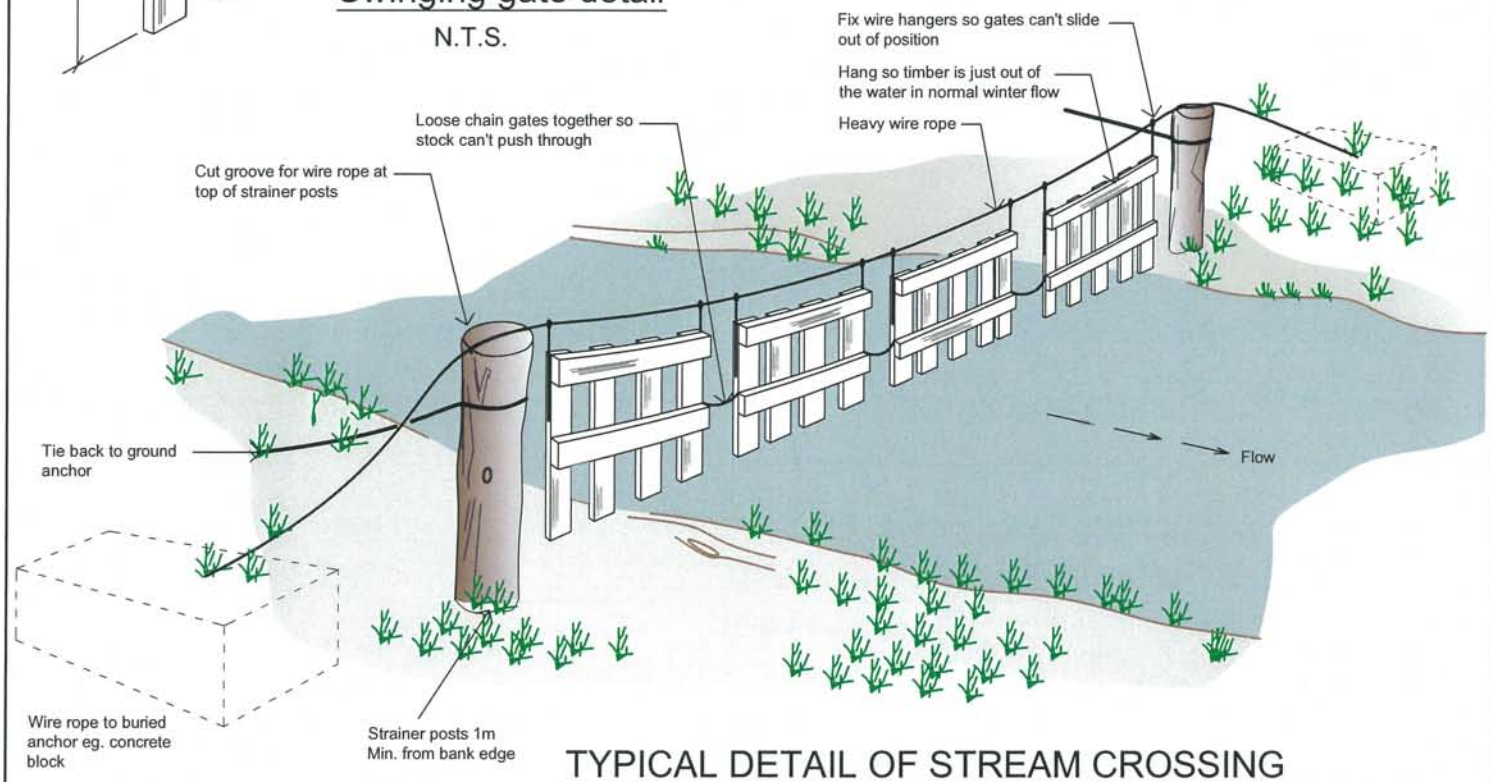
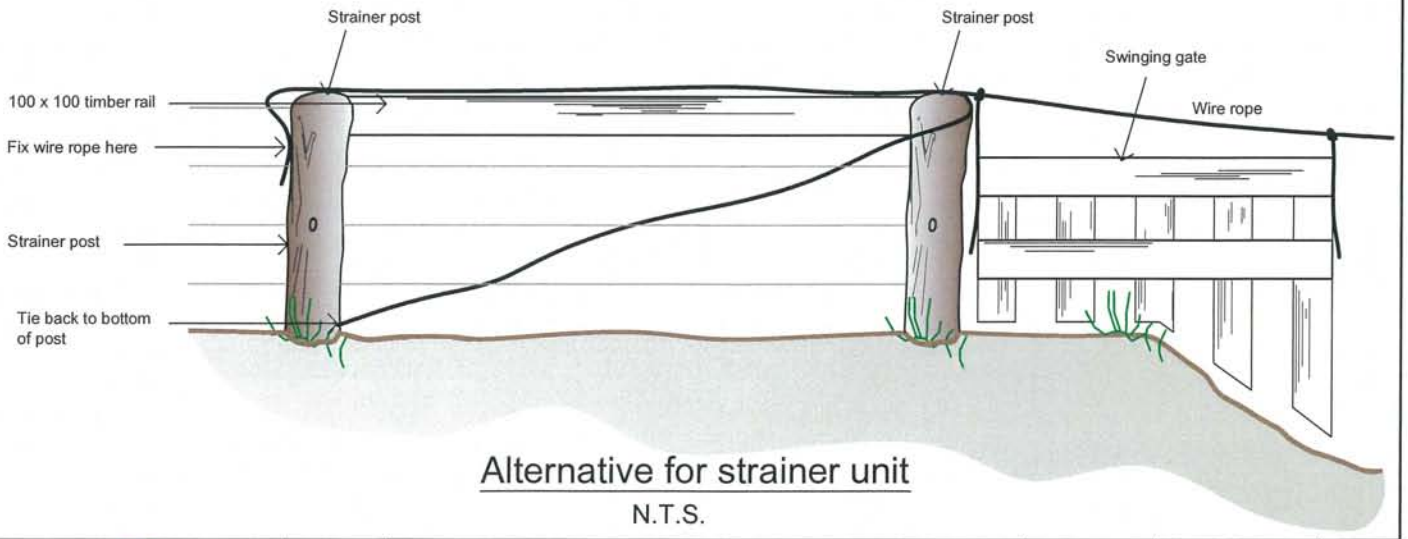


TYPICAL DETAIL OF STREAM CROSSING

N.T.S.



Alternative for strainer unit

N.T.S.

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VERSION #	EROSION REPAIR			
1		DESIGN	COMPILED	
		DRAWN	P.COOK	
	SMALL STREAM STANDARD DETAIL STOCK FENCE ACROSS SMALL STREAM	CHECKED	C-C. Munn	3/5/13
		APPROVED		6/5/13
		Drawing No.	RL-5317 / 11	
		FILE N/50/2/6	Cad: RL-5317_C.dwg	