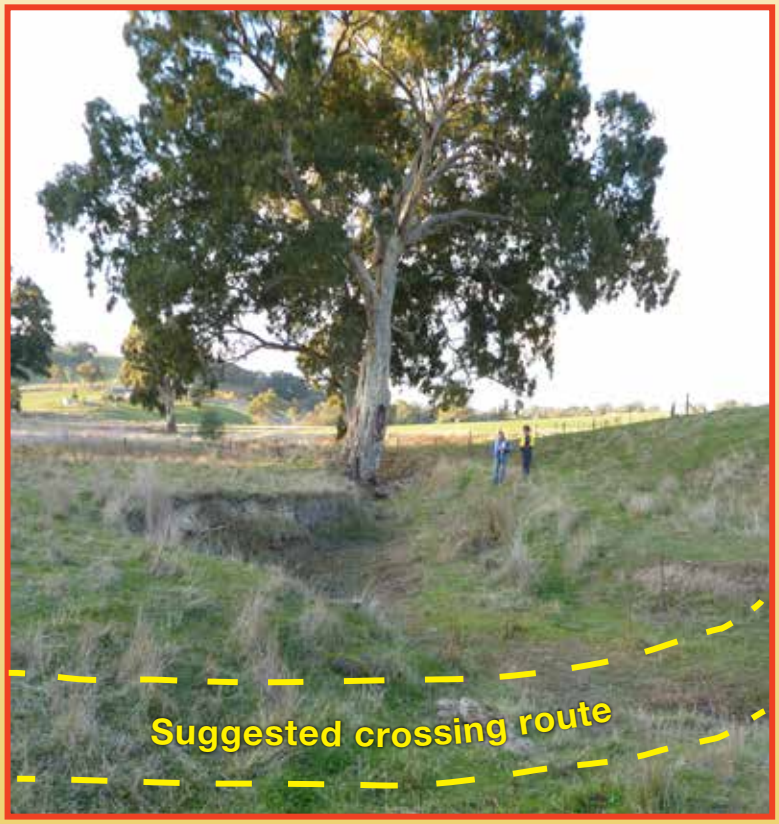
UPPER RIVER TORRENS LANDCARE GROUP

Data Sheet

BEST PRACTICE GUIDELINES FOR CULVERT CROSSINGS

on 1st and 2nd Order Watercourses in the Upper Torrens Catchments

Potential crossing



Choosing a crossing site in an incised creek

The construction of a watercourse crossing constitutes a water affecting activity and as such, a water affecting activities permit must be sought before proceeding with any construction works. Contact your Landscape SA Board Office for further advices regarding WAAs.

Many properties within the Upper Torrens catchment require water crossings of one form or another which allow traffic, pedestrians or stock to cross a watercourse.

The most environmentally friendly and least disruptive form of water crossing involves minimising the disturbance of flow.

This is usually done by armouring the natural channel and banks at the desired crossing point with rock, grouted rock or concrete in a ford style crossing that blends with the natural bed and bank profile such that the watercourse's flow characteristics are preserved.

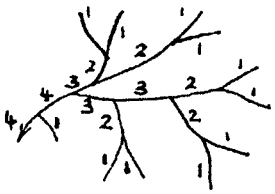
These types of crossings should always be adopted in preference to a raised crossing which contains culverts. However, in some cases a culvert crossing is necessary.

This guide aims to provide advice on the steps required to successfully install a simple culvert crossing on a 1st or 2nd order watercourse in the Upper Torrens catchment outlining the minimum requirements and design considerations that need to be taken into account. The information is provided in the following sections:

1. Site Selection
2. Design Considerations
3. Construction Materials
4. Construction Techniques
5. Maintenance

STREAM CLASSIFICATION

1st and 2nd order streams are the beginning zones of a watercourse system, often shallow or narrow to deep meanders across paddocks. It is the 1st, 2nd and 3rd order streams that move 80% of run-off into the river.



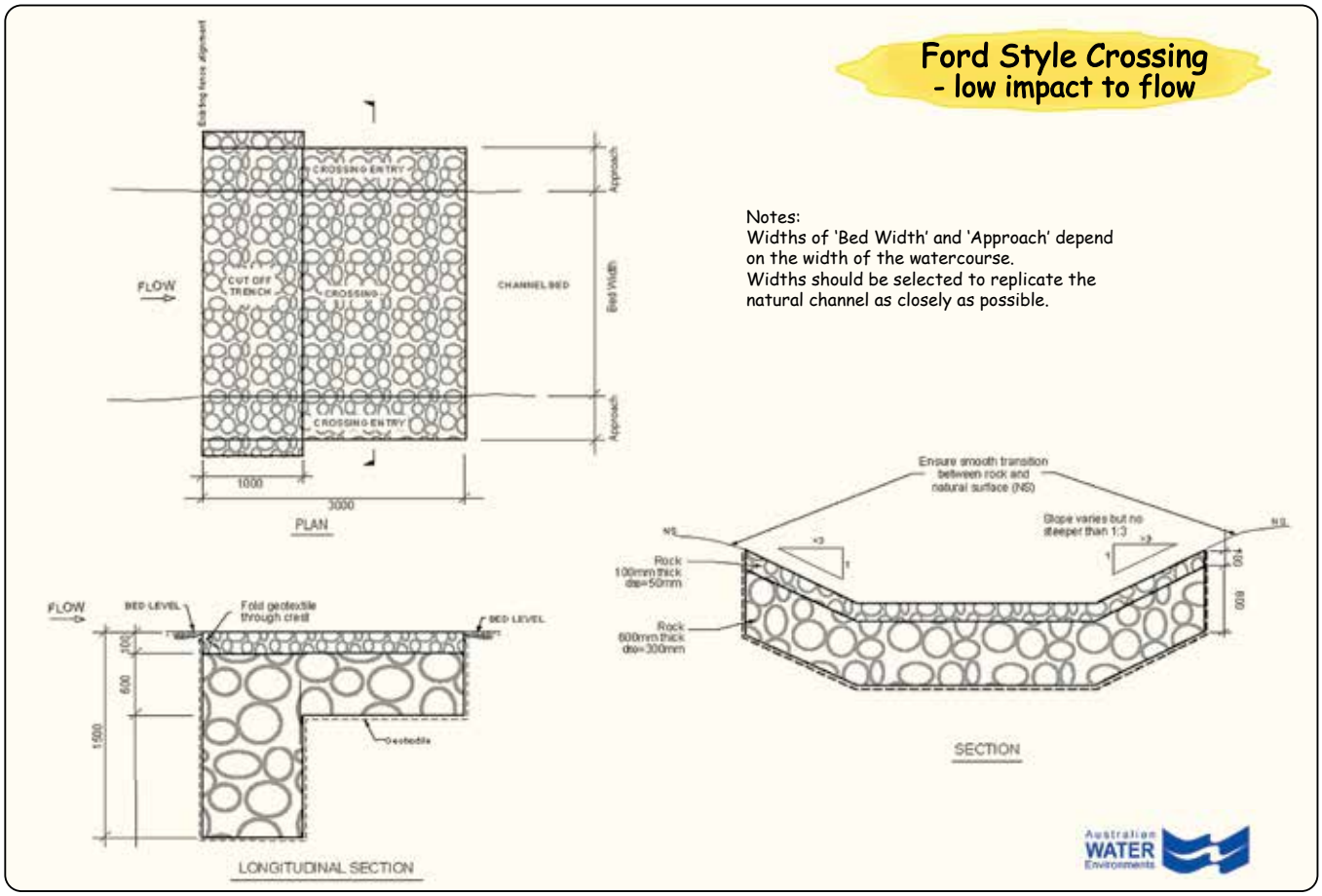


Figure 1 "Ford Crossing Design Template"

1. Site Selection

The selection of the location for installing a watercourse crossing site can have an impact on the overall effectiveness of the crossing.

Consideration should be given to ensure:

- The geology of the crossing point is stable with little active erosion such as scouring or sediment deposition/removal.
- The crossing point is not at a location in which flooding regularly occurs.
- The watercourse to be crossed is inherently stable. Sections where the watercourse is developing a new meandering pattern should be avoided as the watercourse is still developing its stable alignment.
- The crossing point is in a straight, well defined, unobstructed stretch of the watercourse – sharp bends and unstable stretches of the watercourse should be avoided.
- Often a major riffle point such as a shallow-flowing, rocky section will provide a stable bed for the base of a crossing – constructing a crossing either at or immediately downstream of a stable rock riffle will reduce the chance of destabilsing the stream.
- The crossing point is not in an area known to be a habitat for critical fish and wildlife or any other threatened species.
- Works at the location are not likely to mobilise contaminated soils or sediments.
- The crossing is not located at a point which will disrupt the natural spacing of deep pools in the watercourse.
- The approaches to the crossing point have shallow grades which will not be prone to scouring and erosion.

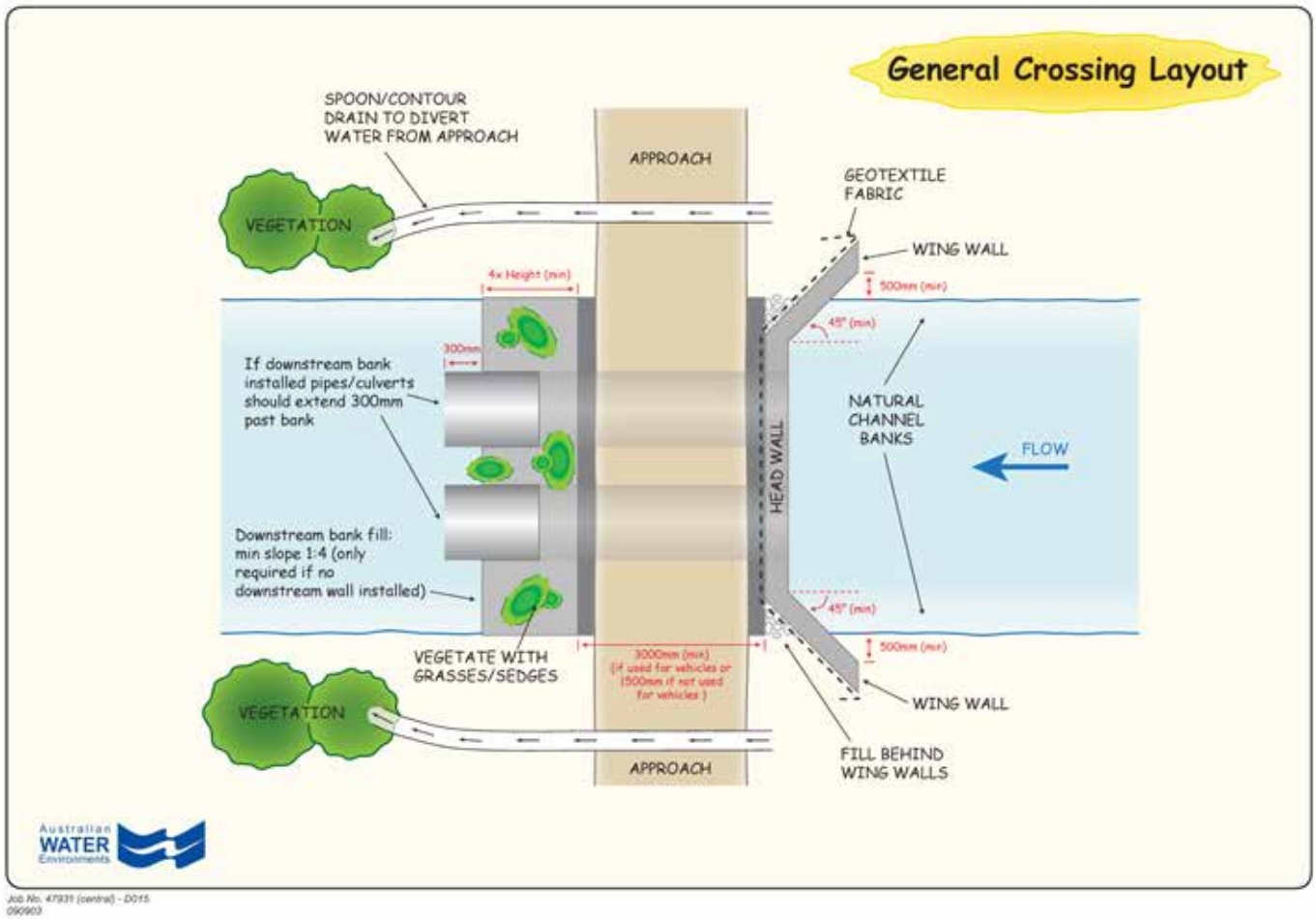


Figure 2 "General Crossing Layout"

2. Design Considerations

The quality of design for the crossing ultimately determines how it affects the watercourse.

When designing the structure, consideration should be given to the following:

- The type of traffic the crossing will be carrying,
- The intended life of the crossing,
- Whether or not culverts are actually required and if so, the type and number of culverts to be used,
- Any environmental considerations (e.g. erosion, fish passage, aesthetics)

As described above, ideally a watercourse crossing will not involve pipes or box culverts (as shown in Figure 1). Ford-style crossings are formed by placing rock or concrete "aprons" across the bed and up the banks of the watercourse. These types of structures are preferred because they can provide a trafficable surface that does not impede or change the pattern of flow in the watercourse. They may be crossed when streams are flowing, requiring passage by livestock or vehicles through shallow water but cannot be crossed during periods of high flow.

Pipe/Box Culvert Selection

All culverts have environmental impacts on the stream, however round pipe culverts tend to be the worst offenders. Low profile square box culverts (preferably open bottomed) are preferred where a culvert crossing is required.

Note: Design Pipe Capacities should be undertaken in consultation with an engineer.

Headwall Design Considerations

The headwall should be designed to efficiently 'funnel' the flow of water through the pipe(s)/box culvert(s) and to eliminate erosive powers acting directly on the crossing which causes erosion, washout and eventual failure.

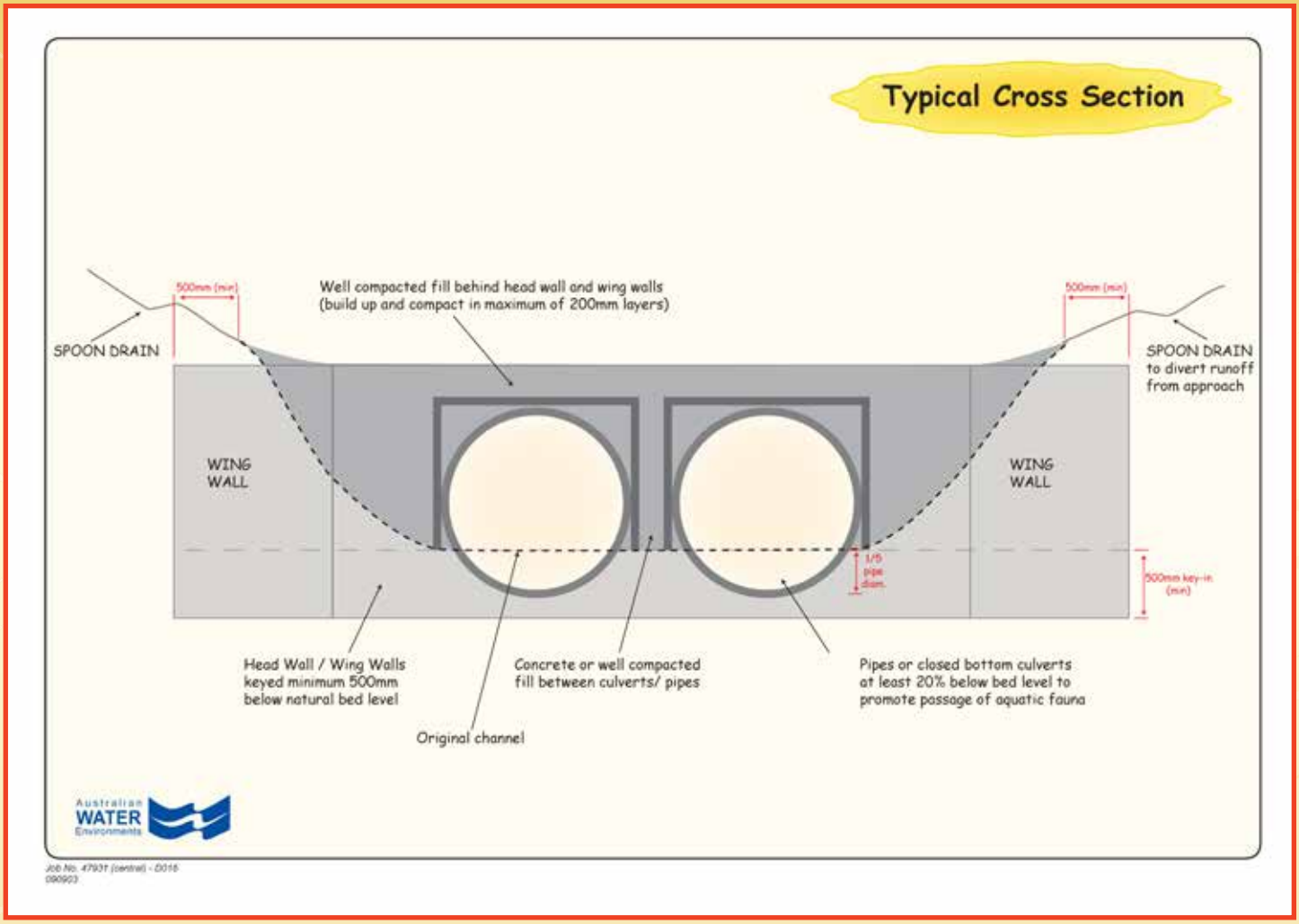


Figure 3 "Typical Cross Section"

Formalised headwalls can be purchased to accompany any purchased pipes/box culverts, however headwalls can be easily constructed from grouted rock or from large rock and geotextile fabric.

Crossing Design Considerations

The design of the crossing itself depends on the intended use of the crossing. Some generic design guidelines for vehicle crossings and non-vehicle crossings are given below and in Figure 2 "General Crossing Layout".

Vehicle Crossings

The minimum design requirements for a crossing intended to carry light traffic (e.g. an access track or driveway) are as follows:

- A vehicle crossing should have a minimum top-width of 3m.
- The upstream and downstream sides of the crossing (aside from the portion protected by the headwall/wing-wall) should have a grade of no steeper than 1:4.
- The pipes/box culverts under the crossing should be flush with the headwall on the upstream side, and should protrude at least 300mm from the crossing on the downstream side.
- There should be a minimum cover of 600mm above the top of the highest pipe/box culvert.
- The approaches to the crossing should be graded to allow for a smooth transition into the crossing.
- Spoon/contour drains should be used to drain water from the approaches away from the crossing and into a sediment trap or roadside vegetation (and not directly into the crossing).

Notes:

1. It should be highlighted that this is for private vehicle access only, and any crossing which will see regular traffic (i.e. more than 10 crossings a day) or is intended for use by heavy vehicles should be designed by a qualified engineer.

2. Non-vehicle crossings follow similar principles.

Large all-weather crossing on a dairy farm.

3. Construction Materials

The materials from which a crossing is constructed, governs its durability and stability and ultimately determines how well the structure will hold up over time. Some minimum requirements for construction materials are given below, however all efforts should be made to use the best available materials wherever possible. Recycled concrete, bricks etc. are not appropriate. Use natural stone.

Pipes/Box Culvert

- All pipes or box culverts should be constructed from pre-cast concrete.

Headwall/Wing-walls

- Headwalls and Wing-walls should provide a smooth transition from the natural channel to the culvert with no discontinuities to allow erosion to begin.

Crossing

- Crossings should be constructed from well compacted fill.

4. Construction Techniques

Pipes/Box Culvert and Headwall

The pipes/box culverts and the connecting headwall should always be the first part of the structure that is put in place. The pipes or culverts should be selected as described by Section 2 and laid out as shown in Figure 3 "Typical Cross Section".

The pipes or box culverts will need to be bedded below the natural bed level of the stream so as to promote fish passage as well as to ensure they are keyed in. Keying in (see Figure 3) should be undertaken prior to laying out the pipes/box culverts and any digging/excavation should be kept as close as possible to the dimensions of the pipes/box culverts so as to minimise disturbances to the stable watercourse bed (whilst still allowing enough space to compact any fill material).

In all cases, the pipes or culverts should be laid at a slope as close as possible to that of the natural channel, and the downstream invert (bottom) of the pipe or culvert should always be no higher than the natural bed level. This is crucial in reducing erosion downstream of the structure, which can ultimately threaten the structure itself.

The headwall should always be keyed into the bed and banks of the drainage path as described previously.

Pre-cast headwall

If a pre-cast headwall is to be installed, this is simply a matter of excavating the bed and the banks to allow the structure to be installed. The structure which has been purchased should have been selected so that it will key in adequately to the banks and bed of the channel. All earthworks required in the channel to key in the structure should be kept as close as possible to the required dimensions so as to minimise disturbance to the natural channel.

Makeshift headwall/wingwall

The easiest method for constructing a headwall/wing-wall is to excavate trenches to allow it to be keyed into the banks and bed, and to line the downstream sides of the key-in trenches with geotextile fabric. The structure should then be built up from within the trenches (in front of the geotextile) to the level of the natural stream bed.

Crossing

The bank and levee, which will provide the crossing point, should always be constructed from suitable materials similar to those described previously.

The earth/soil required to construct the crossing will often need to be brought in using earthmoving equipment. This equipment should also be used for the construction of the levee to ensure that it is constructed and compacted properly.

The earth/soil used for the crossing should always be compacted in layers no thicker than 200mm so as to maximise the effectiveness of the compaction. Compaction should ideally be achieved using a mechanical compaction device or vehicle.

5. Maintenance

After a crossing has been constructed, regular maintenance will help to increase the life of the structure and will assist in early recognition of any possible problems.

The pipes/box culverts should always be kept free of surplus silt and debris so that they can operate at their maximum efficiency.

The structure should regularly be inspected for signs of undercutting, slumping or surface erosions.

If surface erosion has occurred, and the top layer of the structure has been removed, this should be replaced and compacted sufficiently. The root cause of this surface erosion is often due to a large flood event which has caused the structure to be overtopped and thus eroding the top layer, however, if this erosion is due to surface runoff from the surrounding approaches to the crossing then the water should be directed away.

If slumping or scouring is beginning to occur in the structure, there is the possibility for complete failure of the crossing. If this is noticed, engineering advice should be sought.

Vegetating the downstream face of the crossing and the surface of the crossing itself (for low traffic volumes) will reduce the amount of surface erosion and soil loss during overtopping.

Footnotes:

This Data Sheet is an abridged version of the documents developed by Australian Water Environments for the Upper Torrens Land Management Project. All landholders utilising this information do so at their own risk and are encouraged to seek engineering advice and in the event that the landholder's property is in the Upper Torrens Catchment they are encouraged to contact the UTLMP Project Officer for support to undertake their on-ground works. Additional support and information is available from the Landscape SA Hills & Fleurieu Board.

The Landscape SA H&F Board has responsibility for issuing Water Affecting Activities permits and these are available on the Board's website. Search for Publications - Water Affecting Activities.

Enquiries about this data sheet should be made to the Upper River Torrens Landcare Group c/- the Mount Pleasant Natural Resource Centre, 132 Melrose Street, Mount Pleasant; or PO Box 418 Birdwood SA 5235; Phone 08 8568 1907 or www.torrenslandcare.org

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