NEW EQUIPMENT & SYSTEM APPROVAL PROFORMA

Ref: 11/82554

Note: the prompts given below are only a guide to the information required for approval. Dependent on the type of equipment or system that requires approval delete any section that is not applicable or include additional information if necessary. Mandatory fields are marked with an asterisk (*).

1 **Equipment or System to be approved** *

Interflow Expanda and Rotaloc pipe lining systems

2 **Originator** *

Name: Christian Rogers Company: ARTC

3 **Introduction** *

The Expanda and Rotaloc products are two different methods of lining the interior surfaces of severely corroded corrugated steel pipe (CSP) culverts to strengthen them to railway design loading 300LA.. The annulus between the proposed products and CSP culverts is then pressure grouted with cementitious grout. These products are made from PVC or HDPE Plastic by Interflow Ltd, an Australian based company.. The company product information is attached as Attachment 1.

Type Approval is being sought to use Expanda and Rotaloc to line the existing severely corroded CSP culverts with pipes up to 1000mm and 1500mm diameter respectively.

4 **Determination of Need** *

Recent engineering inspections have revealed that a number of CSP culverts have inadequate load carrying capacity for the existing traffic at full track speed due to severe corrosion.

Where the backfill height above the pipes is limited, the culverts can be replaced with new concrete pipes. But as the fill height increases replacement becomes unpractical due to the extensive earthwork and prolonged track possession requirements.

For CSP culverts with over 2m of backfill on top, the common practice is to line them with concrete pipes. Whilst structurally sound, this method of lining significantly reduces the available culvert waterway opening.

The Interflow RotaLoc and Expanda pipe lining methods significantly minimise the reduction in culvert waterway opening, whilst providing full structural support for 300LA design load. Also, the products are virtually maintenance free.

For small pipes, these two products are considered to provide the most cost effective and practical option to rehabilitate the existing substandard CSP culverts.

5 **Significant Change or Not** *(as determined by the Manager Standards)* *

This change in equipment or system is assessed as significant (New supplier, new product)

6 **Review Panel** *(as determined by the Manager Standards)* *

- John Furness – Manager Standards
- Matthew Hart – Senior Project Manager
- Peter Prasad – National Bridges & Structures Engineer
- Adrian Oorloff – Project Engineer

7 **Safety**

Site specific engineering design to ARTC COP – Section 9 "Structures";

Australian Standard AS5100– Bridge design and relevant international and national standards on pipe designs.

Whilst no risk assessment is mandated under the type approval process, it is viewed that the key risks are mitigated through the requirement to undertake site specific design and independent verification to ensure the above standards are being met.

8 **Performance and Suitability**

There are no Australian Standards that specifically address structural lining of railway culverts.

Interflow's Expanda and Rotaloc liners meet the requirements of the following European and ASTM (North American Standards).

- EN13566-7: Plastics Piping Systems for Renovation of Underground Non Pressure Drainage and Sewerage Networks - Part 7: Lining with Spirally-Wound Pipes
- ASTM F 1697: Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits
- ASTM F 1741 Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride)(PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits

When used for structural rehabilitation of deteriorated underground conduits they are designed in accordance with the Specifications of the relevant Authority. Typically Australian Water and Road Authorities require lining to be designed using the method given in Australian Standard AS2566.1 "Buried Flexible Pipelines, Part 1: Structural Design" the Australian Standard for new flexible pipelines installed by traditional trenching, embedment and backfilling. The design method is therefore the same, whether the culvert is replaced with a new culvert, or lined using Expanda or Rotaloc liners.

Sample designs in accordance with the method given in the above Standard, using values of variables typically applied by Australian Authorities, are attached as Attachment 2.

(i) **Use in other rail networks**

Have been used on Rio Tinto railway system in Western Australia carrying 40tal and on some road networks. Refer attached Rio Tinto testimonial (Attachment 3).

(ii) **Use in the ARTC network**

A similar product has been used to reinforce a structure at Cockburn (CBB339) circa 1990. It is formed from 3 pre-fabricated sections. ARTC has no records of any Type Approval of the work as it was installed prior to ARTC formation and such records have not been retained. , Photo included in Attachment 4.

(iii) **Issues arising from usage of the equipment/system**

ARTC structures standards and procedures will require updating to include this new structure type.

(iv) **Changes required to infrastructure or systems for use of the equipment**

Inspection frequencies will need to account for these plastic products.

9 **Reliability**

FATIGUE LIFE:

Being flexible and ductile with a high strain capability, a plastic pipe material is capable of greater resistance to repeated cyclic loading than metal or concrete pipe.

Design of culvert liners considers the effect of cyclic rail loading by calculations in accordance with AS5100.2 "Bridge Design: Part 2: Design Loads. This includes applying a "dynamic load allowance" to take into account the fatigue effects of cyclic loading. (Clause 6.9).The effect reduces with the depth of cover (Clause 6.12).

DURABILITY

The durability of an underground pipeline is mostly dependent on its response to:

- Loading
- Abrasion
- Corrosion

Loading: Plastic pipes and culvert liners are flexible, meaning in terms of pipeline design, they are capable of changing shape under load without losing their structural integrity. While they may deflect under load, they will not crack like rigid pipes such as concrete.

Design of plastic pipes in accordance with Australian and International Standards ensures that under installation conditions deflection does not exceed a certain value. The limiting deflection value incorporates a considerable factor of safety against collapse.

Therefore should the design load be exceeded the plastic pipe may deflect, but its integrity and durability will not be affected. It would only be damaged by a load catastrophically in excess of the design load.

Abrasion: uPVC (Expanda Pipe and Rotaloc liners) is a highly abrasion resistant material that has been used in the pipeline industry for decades.

As conditions that cause abrasion are dependent on pipeline working conditions which are highly variable, abrasion resistance testing has aimed to compare pipeline materials under identical conditions. European Standard EN295-3 has a test method that has become universally used. Testing involves half filling a piece of pipe with gravel and rocking it 45º to 45º for 100,000 cycles. The loss of wall thickness is then measured.

Test reports can be provided showing that after 100,000 cycles, the loss of wall thickness of Interflow's uPVC liner was 0.13mm. This compares favourably to other pipeline materials such as concrete and steel.

Corrosion: uPVC is corrosion resistant. In the pipe manufacturing industry uPVC is used a coating or lining to protect concrete, steel or ductile iron pipes from corrosion.

uPVC is inert in all naturally occurring soils and to any materials that can legally be put in a sewer. They are resistant to

saline and acidic conditions.

UV Resistance

uPVC formulations used in pipelines and in liners installed by Interflow can lose some impact strength under constant UV radiation over the long term if left unprotected. For this reason, the formulations of the uPVC employed in external environments by Interflow have additives incorporated that provide long term UV resistance.

Fire Resistance

Plastics, like many other materials used in the construction industry, can be damaged by fire.

uPVC, as used in Expanda Pipe™ and Rotaloc™ liners, does not support combustion in normal atmospheric conditions. Under furnace conditions it is self-extinguishing once the source of heat is removed.

10 **Maintainability**

Pipes lined with Expanda Pipe™ and Rotaloc™ will have their structural capacity enhanced to design loading and is sealed against infiltration, exfiltration and root ingress.

Maintenance requirements for lined pipes would be minimal and typically be restricted to occasional water jetting to remove any sediment.
The smooth wall of the liner, compared to corrugated metal, means that build up of scale is unlikely.

For pipes lined with spiral wound liners, testing has shown that cleaning with commonly used types of jetters will not cause damage provided the following pressure and flow rate are not exceeded:

- Maximum Pressure: 1,800psi (12.4 MPa)
- Maximum Flow Rate: 187 Litres/minute

The use of high impact de-scaling style nozzles is not recommended.

11 **Approval ***

Interflow Expanda and Rotaloc pipe lining systems for use on ARTC network wide to line existing corroded CSP culvert pipes with up to 1000mm and 1500mm interior diameter respectively.

12 **Conditions of Approval ***

Each site identified for lining must have an individual engineering design certifying the design to line specific railway loading including an independent 3rd party design review. The Expanda liner shall NOT be used in the culverts with pipes greater than 1000mm diameter and Rotaloc liner shall NOT be used in the culverts with pipes greater than 1500mm diameter.

Interflow Ribline liner shall not be used on the network.

13	**Does the Originator accept the additional Conditions of Approval as set by the Review Panel:**	Yes	☑	No	☐	N/A	☐

14 **Sign off** — ***ARTC office use only***

Review Panel:

Peter Prasad		Date: 16-11-2011.
John Furness		Date: 16-11-2011
Matthew Hart		Date: 16/11/11
FOR Adrian Oorloff		Date: 16/11/11