5. Details of the recently installed overflow pipe from the corridor sump to Pit 1 were not sighted during the review. These should be obtained and checked to ensure that adequate overflow capacity is available in the event of the design storm event.

4 Review of existing system and current operating, maintenance and development regimes and responsibilities

4.1 Current inspection, operating, maintenance and development regimes and responsibilities

The overall operating, maintenance and development regime for the tailings corridor is governed by the ERA Ranger general authorisation to operate and the requirements relevant to the tailings corridor are covered, in either specific or general terms, in the WMS operation manual.

The departments within ERA who are directly responsible for aspects of the corridor operation, maintenance and development and their specific responsibilities are as follows:

Department	Responsibilities
Mill (Operations)	• Operation of tailings and return process water supply lines • Inspection of tailings corridor and pipe lines a minimum of 3 and preferably 4 times per shift • Inspection of corridor lines for leaks after storm events prior to pumping of tailings corridor sump contents to RP2 • Management of dams and ponds
Mill (Maintenance)	• Maintenance of tailings pipelines • Maintenance of balance of corridor pipework • General maintenance of tailings corridor
Engineering Services (Mechanical Workshops)	• Maintenance of the process water return line • Maintenance of the Water Management System (WMS)
Engineering Services (Engineering Technical Services)	• Maintenance of drawing records • Provision of engineering support, when requested, for facility upgrades or modifications
Environment Safety & Health	• Overall supervision of tailings corridor operations and development to ensure compliance with the WMS requirements • Conceptual and strategic input for the design of any modifications to the corridor or its associated pipework/ equipment • Liaison with and reporting to the Office of the Supervising Scientist

During the review inspections and discussions, the following general observations were made with respect to the above roles and responsibilities as they apply to the tailings corridor:

1. Corridor maintenance, in terms of cleaning and grading etc, has not in latter years been to the same standards which prevailed during the early stages of mine operations. Recently, however, there has been a recognition of this on the part of ERA and measures are being put in place to rectify the situation. If not already in place, a fully updated formal routine maintenance program and schedule covering these aspects should be drawn up and implemented.

   This program should also include a means of recording maintenance activities carried out.

2. If not already in existence, a means of recording shift etc inspections should be implemented.

3. Whilst significant drawing updates have been undertaken, the process of passing details of all modifications to the Project Technical Services Group for updating of drawings appears to need improvement. If not already in place a formal procedure should be initiated.

4. The above table shows maintenance of the tailings lines to be the responsibility of the Mill Department. However, some discussions on site suggested a desire on the part of the Mill Department to pass this responsibility over to the mechanical maintenance workshops. If this is likely to be considered, it should be cleared up and any role/responsibility changes confirmed as soon as possible to ensure that there is no neglect of the tailings pipelines maintenance.

4.2 Pipe materials and condition/integrity

Table 4.1 summarises the main details of the corridor pipework along with summary comments on current condition/integrity and also some general pertinent observations. The main findings of the review are summarised as follows.

A recently completed ultrasonic inspection of the tailings and process return lines by pipe testing specialists, Intico, has not found any evidence of metal wall thickness reduction in these lines.

Unfortunately the methods employed do not permit the condition of the pipe ends in the region of the victualic couplings to be examined. Neither does it allow the condition of the tailings lines polyethylene lining to be assessed.

The evidence presented during the review suggests that degradation of the lining in the tailings lines is not likely to be an issue at present. This should, however, be confirmed by identification and review of all available evidence in this regard. Should this evidence, or a desire to obtain more conclusive information of the lining condition, indicate a requirement for further examination this can be undertaken.

One available method, based on preliminary discussions with specialist contractors, is the use of an Intelligent Caliper Pig to survey the lining condition. This is a device, capable of recording pipe internal details, which travels down the line either under its own power or the motive power of the fluid in the line. This particular pig technology is not currently available in Australia, however, it is can be made available on a fly in fly out basis from overseas. It tends to be expensive with mobilisation/demobilisation costs being a considerable part of the cost. It would be possible to offset some of the mobilisation/ demobilisation costs if there were other lines at the site which merited similar investigation.

Table 4.1 Description of pipelines in the Tailings Dam Corridor

Stream Description	Line Diameter	Pipe Material	Coupling Type	Condition/ Integrity	Comment
Tailings Line A	250 mm	HDPE lined ERW carbon steel. Some flanged hose included.	Victualic except as noted for flanged hose.	Recent ultrasonic(U/S) testing suggest that the carbon steel pipe is in good condition throughout its main length. The condition of the pipe ends at the couplings is thought to be good but cannot be confirmed by the recently employed U/S testing. The condition of the lining, whilst not currently suspect, is unknown and cannot be tested by the above U/S method. Recent ultrasonic testing of pipes made surplus in the move to Pit 1 revealed no measurable wear.	Methods to non destructively (and if possible, in service) testing the lining condition are available if required.
Tailings Line B	250 mm	HDPE lined ERW carbon steel. MDPE lined in the corridor branch. Some flanged hose included. Also, two rubber lined steel sections in the vicinity of the corridor sump	Victualic jointing in the main corridor and flanged in the corridor branch and as noted for hose.	As above for tailings line A The flange guards are not correctly fitted	As above for tailings line A
Process Water Return	250 mm	Internal epoxy painted carbon steel. Some MDPE lined ERW or spiral welded steel. Some flanged hose where bolts have corroded	Victualic mainly and some flanged.	Condition believed to be generally good based on previous inspections The condition of the pipe ends at the couplings is suspect but cannot be investigated by the recently employed U/S testing. Some recently installed sections have been painted on the outside instead of the inside. Flange guards not correctly fitted and sometimes not fitted in B corridor extension.	Progressive stripping and painting of the coupling joints to prevent deterioration of the pipe ends and reduce the risk of joint failures recommended
Tailings Sump Discharge to RP2	110 mm	MDPE	PP compress'n fittings		This is laid on the ground at each end and draped over the corridor main pipelines over most of the route.
Process Water Pit 1 to Tailings Dam	500 mm	MDPE	Butt Welded Joints with welded flanged joints at intervals and fittings		
Process water Tailings Dam to Pit 1	500 mm	MDPE	Butt Welded Joints with welded flanged joints at intervals and fittings		

Discussions with specialist contractors have suggested other suitable and possibly less expensive internal inspection methods may also be available. However, at the time of writing this report, conclusive information has not yet been received.

The condition of the pipe ends is a concern primarily in the case of the process water return line. A program of progressive stripping and painting of the internal and external pipe ends to prevent further deterioration of the pipe ends and reduce the risk of pipe failures is recommended.

4.3 Pipe support

Pipe support is provided as follows:

Stream Description	Section	Support Type
Tailings line A	• Main tailings corridor	• Concrete pipe supports
	• Branch corridor to Pit 1	• Concrete pipe supports
Tailings line B	• Main tailings corridor	• Concrete pipe supports
	• Branch corridor to Pit 1	• Concrete pipe supports
Discharge line from tailings corridor sump pump to RP2	• Discharge from tailings sump	• Steel pipe supports
	• Main tailings corridor run	• Concrete footings
	• End of tailings corridor on route to RP1 surge sump on west side of tailings pumps	• Sitting on the ground
Tailings – tailings dam to Pit 1	• Branch corridor to Pit 1	• On ground
	• Main tailings corridor	• On ground in drainage trench
Process water - tailings dam to Pit 1	• Branch corridor to Pit 1	• On ground
	• Main tailings corridor	• On ground in drainage trench
Process water return pipe	• Branch corridor to Pit 1	• Concrete pipe supports
	• Main tailings corridor	• Concrete pipe supports

Support designs and spacings appear to be generally in accordance applicable standards, good engineering design practice and, where applicable, vendor recommendations. No specific issues came to light during the review investigations.

4.4 Pipe jointing

Pipe jointing details are provided in table 4.1. The following findings are noted:

1. The most vulnerable aspect of the tailings and process water return lines is the joints. Victualic jointing has been adopted for the reasons given in section 3.1.2 of this report. Risks/problems encountered include the following:

- The sealing surface on the pipe is easily damaged during construction and maintenance by rough handling. Consequently, leakage occurs and corrosion of the surface steel then causes failure of the pipe groove used by the victualic clamp. This allows the joint to fail in tension which it cannot normally do while constrained within the pipeline.
- The couplings are made of SG iron and are therefore more corrosion resistant than the steel. Handling of the pipework carefully when fitting the couplings is important to minimise damage to the pipework. If it is not already the case, the manufacturers instructions for installation of the couplings should be included in a standard maintenance procedure for this activity and monitored accordingly.
- The epoxy lined pipes (process water return) are most likely to fail due to corrosion at the joints as the painting is thinner around the sharp corners because they are more difficult to paint and very easy to damage. Extra care is therefore necessary during construction to prevent handling damage in this area.
- The quality of couplings has been a problem in the past when pirate versions of victualic couplings were purchased and installed from new. Genuine victualic couplings of the correct metric or imperial as appropriate size only should be used.

2. Undersized bolts are suspected of having been a factor in the recent joint failure on the process water return line referred to in section 3.3 (item 4). If not already carried out, a check should be undertaken on bolting in all suspect areas to confirm that correct size and material of bolting has been used.

4.5 Redundant pipework

There is some redundant pipework remaining in the corridor from previous operations. This pipework should be assessed as to any future use for the corridor services and removed at a suitable time if it is not intended to use it. This will result in the corridor being less congested in these areas and will aid future corridor maintenance (refer 4.6 below). Pipework identified as being apparently redundant with known details is as follows:

Diameter	Material	Location	Past Function
250 mm	Polyurethane lined steel	Nearly full length of corridor	Old CD line to tailings dam
150 mm	Steel	Past corridor sump	
150 mm	Steel	Corridor sump manifold to old tailings CD line	Corridor sump water to the tailings dam
150 mm	Steel	Corridor sump pump manifold	Corridor sump water from the sup pumps to the tailings dam

4.6 Maintenance of the corridor

As noted in 4.1 above, general corridor maintenance has been recently recognised by ERA as needing attention and measures are currently in hand to achieve this. Problems which have arisen due to reduced or changed maintenance practices include the following:

1. Grading of the corridor road has resulted in surface material being pushed onto the pipetrack area with the result that, in certain areas, the corridor pipework was either partially or fully buried which is contrary to the design intent. This in turn results in a number of risks/problems as follows:
   - Some external wall corrosion of the pipework and bolts has occurred
   - Thermal expansion of the pipelines could be restricted
   - Early detection of any leaks is less likely
   - The drainage of the corridor road into the corridor drain channel is inhibited with the result that breakthrough channelling and scouring of the corridor surface has occurred particularly in the vicinity of the corridor sump
   - Surface material can be dragged into the corridor drainage channel thereby reducing the design effectiveness of this channel
   - Surface material will have been lost in the clean up removal process and may have to be replaced in order to maintain design levels and contours.

   The regrading process for the tails road should ensure that scraped material is re-compacted (into the road surface) and does not end up being left in the pipetrack so as not to reduce design clearances and not cause the other problems noted above.
2. In the early days of mine operation, the maintenance regime included placing weed killer to prevent the growth of grass and weeds on the corridor particularly along the pipe track in the drainage trench. This practice has, however, subsequently lapsed with the result that extensive growth of grass and weeds occurred. Problems encountered as a result of this include:
   - The corrosion and accidental fire risks are increased. Exposure of pipes to fire is a problem even for steel pipes as here they are usually lined and have rubber seals in the victualic joints and they have linings.
   - Visibility of leaks is reduced
   - There has been a practice of removing the grass using cold burning and, whilst operation should be carefully supervised, there is always the risk of fire damage to pipe internal linings/coatings using this process

   A regular program of poisoning should be re-introduced to the corridor maintenance program to keep grass and weeds at bay.
3. There is some evidence that corridor side embankment heights/integrity might, in a few locations, not be as per the original design. A general survey of these embankments should be undertaken to confirm compliance with original design and remedial action taken if appropriate.

4.7 External threats

External threats were considered as part of the review and the following points are noted:

- The catchment area 11A stockpile is positioned very close on the northern side of the corridor. There may consequently be a risk of damage to the adjacent corridor pipelines due to falling rocks. Consideration should be given to moving the stockpile edge back and/or reshaping the stockpile in this area to reduce the risk of this occurring. This work

would logically be carried out at the same time as any work to increase the width of the corridor in this area as recommended in section 3.3 above.

4.8 Current developments

Ongoing current developments which impact either directly or indirectly on the tailings corridor are as follows:

- New 500 mm Polyethelene sections are being installed in the process water transfer lines between the tailings dam and Pit 1. This is due to the original sections having been damaged by fire apparently caused by the burning of bolts to break a flange connection.

4.9 Environmental

The roles and responsibilities of the ERA Environmental Health and Safety department in respect of the tailings corridor are briefly summarised in section 4.1. There were no specific issues in this regard which came to light during the review investigations

5 Anticipated future developments

There are no currently anticipated future developments which it is envisaged will, either directly or indirectly, impact the tailings corridor during the operating life of the mine.

6 Discussion and recommendations

The significant finding of this report is that, whilst there are a number of matters that need to be checked/addressed, the fundamental design and operation basis for the corridor was appropriate at the time of initial construction and operation, and is still appropriate. It has not been practical, in the time available to undertake and document this review, to follow all of the issues through to obtain full details and make final recommendations. Accordingly, in respect of a number of items, this report includes recommendations for further consideration before deciding on any action.

Whilst a number modifications affecting the corridor are recommended for further consideration, the main findings/ recommendations of the report relate to operating and maintenance practices which should be adopted for the remainder of the mine/mill life.

The review recommendations are summarised as follows primarily under the report headings used in section sections 3.3 and 4 of this report.

6.1 Suitability of key aspects of the original design

- Investigate the widening of the western end section of the corridor where the 500 mm polyethylene pipes run in the drainage trench in order to reduce the risk of a pipe leak resulting in contaminated water falling outside the corridor embankment. Incorporate an examination of the other potential impacts of the polyethylene pipe routing noted in this report as part of the review.
- Obtain and review the particle grade and impermeability etc specifications for all main and branch corridor coverings to confirm their acceptability with respect to prevention of seepage/leakage from the corridor.
- Specifically review all areas where the original corridor base material has been significantly disturbed/altered to ensure that the cover now provided is adequate.